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JULY 1, 1953 to JUNE 30, 1954

AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE COLLEGE

OF AGRICULTURE AND MECHANIC ARTS

BROOKINGS, SOUTH DAKOTA



Letter of Transmittal

DEAN A. M. EBERLE
Agricultural Division
South Dakota State College

Dear DEAN EBERLE:

The sixty-seventh Annual Report of the South Dakota State College Agricultural Experiment Station is presented herewith. The first 100 pages were included in the *South Dakota Farm and Home Research* quarterly (Vol. V, Nos. 1 to 4 inclusive). The succeeding pages present a brief statement of the research not included in the issues of the quarterly.

The Station's research activities have been greatly enhanced by the new laboratories in Agricultural Hall. With the completion of the Plant Pathology laboratory and greenhouses now under construction, the research on plant diseases will be stepped up immeasurably. Even though these facilities have been or are being added, the Station is constantly under pressure to catch up with the research needs of our agriculture. Farm problems are constantly arising which call for more trained scientists, more land, and more facilities. The national agricultural programs, of which we are a part, pose new problems in soil and moisture conservation, farm management, the effective use of diverted acres, crop storage, and marketing.

More productive hybrid corn varieties are being developed. Three new crop releases were distributed to the County Crop Improvement Associations, namely, Selkirk spring wheat, and Waubay and Dupree oats. Two new shelterbelt trees, adapted to the rigorous climatic conditions of the Northwest, have been released for increase by the nurseries. A limited number of these trees may be distributed in another year.

Farmers and ranchers of the state are taking a greater interest in the work of the Station as evidenced by the increased attendance at our various Field Days, the calls at the county agent offices throughout the state, and the ever increasing amount of correspondence pertaining to the farm and home problems presented by the citizens of the state.

Respectfully submitted,

A handwritten signature in cursive script, reading "C. B. Johnson". The signature is written in dark ink and is positioned above the printed name of the Director.

Director, Experiment Station

Agricultural Research in South Dakota

Sixty-seventh Annual Report

July 1, 1953 to June 30, 1954

South Dakota Agricultural Experiment Station

I. B. Johnson, Director



SOUTH DAKOTA STATE COLLEGE
of Agriculture and Mechanic Arts

Brookings, South Dakota

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Artificial Milk

FOR BABY PIGS

A convenient and readily available feed to use for orphaned pigs, for very small litters, for extra pigs from large litters, or for supplementing the milk of poor producing sows. It will enable your pigs to get off to a much better nutritional start in life.

By RICHARD C. WAHLSTROM

EVERY PIG farrowed alive stands almost one chance of losing his life before he is weaned for every two chances he has to survive. Many of these losses are unnecessary and the proper use of artificial milk may help to decrease this drastic loss in swine production.

During the past two years much has been written about the practical use of artificial sow's milk. Many claims have been made, some true, some false, and the success of the average hog producer has varied from good to poor when these products have been used.

To obtain more information on the proper management of pigs raised on the artificial milk system, as well as the cost and feasibility of this system under practical farm conditions in South Dakota, an experiment, consisting of three trials was undertaken in the spring of 1953 using two commercial artificial milk products.

Experimental Plan Outlined

In each of the three trials the pigs were raised in 8-foot by 8-foot con-

crete floored pens that are used for farrowing pens. A triangular wood-floored brooder was placed in one corner of the pen and heated with a 200-watt light bulb. The artificial milk was fed in a 5-gallon pig fountain the first two days and in a creep trough thereafter. After the second day, water was supplied in a 5-gallon fountain. A creep ration was available in a self-feeder at all times.

The main difference between the three trials was in the age that the pigs were removed from the sow and started on the artificial milk. In the first trial, pigs averaging 20 days of age were used; in Trial II, they were 9 days old, and in Trial III, 4 days old when started on the experiment. In each trial the pigs were divided into two lots, the only difference between lots being in the artificial milk which was fed.

After the pigs were removed from the sow they were not fed for three or four hours. Their noses were then dunked in the milk the first one or two feedings and no difficulty was encountered in getting the pigs to drink from a trough. The milk was

Table 1. Pig Starter Ration

| Ingredient | Percent |
|--------------------|---------|
| Rolled oats | 50.0 |
| Ground yellow corn | 30.0 |
| Soybean oil meal | 13.0 |
| Tankage | 5.0 |
| Limestone | 0.5 |
| Steamed bonemeal | 0.5 |
| Trace mineral salt | 0.5 |
| BiCon 3+3* | 0.5 |
| Vitamins† | + |

*Contained 3 mg. of vitamin B₁₂ and 3 grams of terramycin per pound.

†Per pound of ration: niacin 5 mg., pantothenic acid 5 mg., riboflavin 1 mg., 1000 USP units vitamin A and 125 USP units vitamin D₃.

fed three times daily until the pigs were 3 weeks old and twice daily from the third to fifth or sixth week when they were given dry feed only.

In Trial I the milk was fed as a gruel for the first week and in dry form for two more weeks while in Trials II and III the milk was fed in a liquid form according to the manufacturer's directions. In Trial I a pig starter meal was fed, the compo-

sition of which is given in Table 1. In the second and third trials this pig starter ration was fed in one compartment of the self-feeder and a sugar-coated pelleted pig starter was fed in the other side of the feeder.

Sow Can Still Raise Pigs More Economically

The results of the three trials are summarized in Table 2. In two of the three trials the heaviest pigs at weaning time were those fed the artificial milk designated as No. I, while the reverse was true in the first trial. However, since both groups within a trial received the same amount of dry artificial milk it appears that the reason responsible for the difference in weaning weight was the amount of pig starter (meal creep and sugar pellets) consumed.

The pig starter ration consumed by Lots I and II exceeded that of the other four lots, although these last four lots had access to sugar-coated

Table 2. Results of Feeding Artificial Milk to Baby Pigs. Three Trials

| | Trial I | | Trial II | | Trial III | |
|--------------------------------------|---------|--------|----------|--------|-----------|--------|
| | Lot I | Lot II | Lot III | Lot IV | Lot V | Lot VI |
| Number pigs started | 10 | 10 | 9 | 9 | 9 | 9 |
| Number pigs finished | 10 | 10 | 9 | 9 | 6 | 7 |
| Average initial age, days | 20 | 20 | 9 | 9 | 4 | 4 |
| Average initial weight, lbs. | 12.6 | 12.6 | 5.6 | 5.5 | 5.0 | 4.9 |
| Average final age, days | 55 | 55 | 51 | 51 | 53 | 53 |
| Average final weight, lbs. | 34.6 | 38.3 | 25.7 | 30.1 | 31.0 | 26.0 |
| Average 56 day weight, lbs.* | 35.2 | 39.1 | 28.5 | 33.4 | 33.0 | 27.6 |
| Artificial milk fed, number | I | II | II | I | I | II |
| Average feed consumption, lbs. | | | | | | |
| Milk (dry) | 7.5 | 7.5 | 10.9 | 10.9 | 14.5 | 14.4 |
| Meal creep | 51.1 | 61.4 | 10.0 | 18.3 | 12.5 | 7.9 |
| Sugar pellets | | | 13.9 | 13.6 | 25.0 | 17.9 |
| Total dry feed | 58.6 | 68.9 | 34.8 | 42.8 | 52.0 | 40.2 |
| Pounds feed per pound gain | 2.66 | 2.68 | 1.74 | 1.74 | 2.0 | 1.90 |
| Feed cost per pig (artificially fed) | \$4.94 | \$4.51 | \$3.76 | \$5.43 | \$7.10 | \$4.71 |
| Cost per pig (sow fed)† | \$3.15 | \$3.15 | \$3.36 | \$3.36 | \$3.92 | \$3.92 |

*Adjusted weight using factors developed by South Dakota Agricultural Experiment Station.

†Based on records of twelve sows and litters, average of six pigs per litter.

CAREFUL MANAGEMENT NECESSARY

1. Better results will usually be obtained if the pigs are left on the sow 7 to 10 days.

2. Supplemental heat is important. Pigs will probably get wet regardless of the type of equipment used, although partitioned troughs eliminate some of this trouble. Wet pigs will chill easily so prevent drafts and have inexpensive heat lamps for young pigs.

3. Milk may be fed as a gruel for a few days and then in dry form, if desired, to pigs one week old or older.

4. Do not overfeed. Follow manufacturer's directions and if any scouring is encountered reduce the amount of milk fed immediately.

5. Allow the pigs access to a palatable pig starter ration and fresh water at all times.

6. Keep equipment and pens clean.

7. Divide pigs into groups as to size with a maximum of 10 pigs per pen.

8. Allow adequate pen space—4 square feet per pig for the first four weeks and 6 to 8 square feet for the next three to four weeks.

pig starter pellets. In Lots V and VI the pigs started eating the sugar-coated pellet first, and in fact some difficulty was encountered in getting these pigs to eat the meal ration.

Only in Trial III when the pigs were removed from the sow at 4 days of age was any mortality encountered. The causes of death here seemed to be a combination of scouring, chilling and, eventually, pneumonia. This emphasizes the fact that better care and more frequent feedings may be necessary to obtain satisfactory results with younger pigs.

Based on the cost of feed which each pig consumed during the time it was on this experiment it is evident that the sow can still raise pigs more economically than we can by artificial feeding. The variation in cost between lots within each trial is due to the difference in cost of the two artificial milks which were used.

Start on Small Scale

Artificial milk is a convenient and readily available feed to use for orphaned pigs, for very small litters, for extra pigs from large litters or for supplementing the milk of poor producing sows. If properly used it will enable the pigs to get off to a better nutritional start, will aid in the control of certain diseases, decrease number of runts and increase the number of pigs weaned and their weaning weight. It must be remembered that the greatest death losses in baby pigs occur during the first three days of the pig's life so that careful management will have to be employed up to this time in order to increase the percentage of pigs weaned and marketed.

The producer who is interested in feeding artificial milk would be wise to start out on a small scale and gain experience. It has definite advantages but may also have many pitfalls. (Project 236. Leader: Richard C. Wahlstrom, Animal Husbandry.)

Alfalfa Silage

versus

Alfalfa Hay

For Wintering Yearling Heifers

By CHASE WILSON and EMERY BARTLE

Very little difference showed up between the two groups except that heifers on silage had a rougher coat. The silage heifers made cheaper gains.



YEARLING HEIFERS fed alfalfa silage as their only roughage made nearly as good gains and did as well as their half-sisters in another group which were fed cured alfalfa hay, and at considerably less cost.

To compare the feeding value of alfalfa silage with alfalfa hay, the Dairy department started a feeding trial in November 1952. Twelve heifers, approximately 8 months of age, were divided in two equal groups with respect to breed, size, age, and relationship.

The actual feeding trial was begun on November 16 following a 10-day preliminary feeding period. The only difference in the rations of the two groups was that the alfalfa was made into silage for one group, whereas it was cured and made into baled hay for the other group.

Both the silage and the hay were good quality first-cutting alfalfa, cut early in the summer of 1952 (Table 1). For the silage, the alfalfa was allowed to wilt slightly in the field, but no preservative was added. Each heifer in both groups received 3 pounds of grain a day for the entire feeding period.

The experiment was continued until May 28, when both groups of

Table 1. Chemical Analysis of Feed

| | Alfalfa Hay Percent | Alfalfa Silage Percent |
|--------------------------------------|---------------------------|------------------------------|
| Moisture | 9.30 | 58.94 |
| Ether extract (dry basis) | 1.63 | 2.76 |
| Crude fiber (dry basis) | 28.76 | 25.62 |
| Protein (dry basis) | 18.30 | 19.01 |
| Ash (dry basis) | 9.58 | 9.43 |
| Nitrogen free extract (dry basis) | 41.73 | 43.18 |
| Carotene (dry basis) mcg/gm | 7.08 | 70.23 |

Table 2. Growth Record of Heifers in Feeding Trial

| Six Heifers in Each Lot Fed for 193 Days | Alfalfa Hay | Alfalfa Silage |
|---|-------------|----------------|
| Average weight per heifer at beginning, lbs. _____ | 447.0 | 464.0 |
| Average weight per heifer at end, lbs. _____ | 711.0 | 702.0 |
| Average gain per heifer, lbs. _____ | 264.0 | 238.0 |
| Average daily gain per heifer, lbs. _____ | 1.36 | 1.23 |
| Average growth (increase) in chest circumference, in. _____ | 11.25 | 10.10 |
| Average growth (increase) in height of withers, in. _____ | 5.67 | 5.05 |

heifers were turned on pasture, making a total of 193 days on trial.

Two Groups Compared

The only observable difference between the two groups was that the heifers fed on silage appeared to have a slightly rougher hair coat than the heifers fed on hay. The heifers on silage also exhibited a desire for something dry to eat in excess of their grain. Since they were taking in so much water with their silage, they did not get as much dry matter as the other group. As a result, they did not make quite as much growth (Table 2).

It will be noted from the table that the heifers on the alfalfa hay made slightly more growth as evidenced by gain in body weight, increase in chest circumference and increase at height of withers. However, the heifers on silage made more growth per pound of dry matter consumed (Table 3). They also made cheaper growth.

The total winter roughage cost for the hay was \$33.12 per heifer. For the silage, it was \$15.36. This follows the same pattern that was reported by workers at Pennsylvania State College where the total annual roughage cost per dairy bull was \$50 less for the ones fed on grass silage as compared to the ones fed on cured hay. These bulls did equally well in all respects as did the bulls on hay.

It does not appear practical to incur the greater expense of feeding a large quantity of hay to get the little extra growth that was obtained in this study. However, feeding the alfalfa silage free choice plus about 5 pounds of cured hay per head daily would give added dry matter. This would perhaps give maximum growth and still keep the cost of raising the heifers relatively low. This will have to be determined in future research. (Project 227. Leader: Chase Wilson, Dairy Dept.)

Table 3. Feed Consumed

| Six Heifers in Each Lot Fed for 193 Days | Alfalfa Hay | Alfalfa Silage |
|--|-------------|----------------|
| Consumed per heifer (193 days), lbs. _____ | 2,745 | 4,619 |
| Consumed per heifer per day, lbs. _____ | 14.22 | 23.93 |
| Roughage dry matter consumed per heifer (193 days), lbs. _____ | 2,490 | 1,897 |
| Roughage dry matter consumed per heifer per day, lbs. _____ | 12.90 | 9.83 |
| Grain consumed per heifer (193 days), lbs. _____ | 579 | 579 |
| Average gain per lb. of roughage dry matter consumed, lbs. _____ | 0.105 | 0.125 |
| Cost per ton delivered _____ | \$20.00 | \$6.00 |
| Roughage cost per heifer (193 days) _____ | \$33.12 | \$15.36 |

By GERALD C. ZOERB

A NEW IDEA in temporary silos was tried out this past season at the Agricultural Experiment Station. It is an above-ground trench silo which promises to have definite advantages over other temporary silos, particularly in wet locations where it is impossible to use a below-ground trench.

The silo was constructed by the Agricultural Engineering department as a possible solution for farm-

per ton of storage capacity. Compared to the cost of a concrete stave upright silo of equal storage capacity, this cost less than one-half.

This Is the Way It Was Built

Six-inch creosoted pine posts and 2" x 6" lumber were used in the construction of this silo. It has a trapezoidal, or hopper-shaped, cross section with a bottom width of 12 feet, a top width of 16 feet, and a depth of 8 feet. It is 60 feet long.

THIS TRENCH SILO

ers who have lately had more grass silage than they have had upright silos to store it in. One of its advantages is that it is particularly suited to flat locations where ordinary trench silos would require special precautions for drainage. Also, the materials used in its construction are readily available and easy to work with.

It is possible to let the animals self-feed from this structure by using a simple feed rack which pushes inward as the material is fed. Though feeding has just started at the experimental silo, it is expected that the self feeding will result in a big labor saving.

The materials for this above-ground trench silo cost \$385. The self-feeding gates and the support rails were another \$146. However, a farmer would probably have need for only one self-feeding gate which would cut the cost to \$98. This gives a total cost for the silo and one self-feeding gate of \$438, or about \$4.10

The trapezoidal cross section was used to insure a tight fit, or constant contact, between the retaining wall and the silage as it settled, and thus prevent air from entering. When level full, the silo has a 117.5-ton capacity at 35 pounds per cubic foot of chopped grass silage.

All of the lumber used for construction was No. 3 grade except that used in the 2" x 6" "A" framework, which was No. 1 material. By employing an "A" shaped framework, a sloping side wall and increased rigidity of the structure were attained. All of the holes for the bolted "A" framework were drilled in the shop and the framework was assembled at the silo site.

The post holes were dug by hand at an angle of 75 degrees with the horizontal. This could be done with a power-take-off driven auger if one of the rear tractor wheels were raised on blocks the proper amount, but at this location digging by hand was relatively easy. A small wooden



Particularly suited for flat locations since it requires no special drainage

Was Built Above Ground!

frame was made to serve as a guide when digging and thus assure the correct angle. It was found to be advantageous to assemble the "A" frame before the post was placed in the ground. They were set to a depth of three feet.

The post framework had a 6-foot spacing; 12-foot 2" x 6" were used for the walls, and hence the joints were staggered. Very little difficulty was encountered in lining up the framework sections to make a straight wall. Before the silo was filled, the walls were covered with sisalkraft paper.

Self-Feeding Gates Installed

The self-feeding gates, one at each end of the silo, were supported by two steel railings of angle iron, which were mounted above the side walls. Steel pipes (1½-inch) were welded to the top angle iron and bolted at the bottom to three 2 by 6's, which formed a 1½-foot "trough" between the silage and the lower

end of the gate. By placing pin holes, drilled at 18-inch spacings in the gate support railings, the position of the gate can be controlled. When the cattle have eaten as far as they can reach, two pins are moved to the next holes.

Continued on page 20

A self-feeding gate made of steel pipes. When the cattle have eaten as far as they can reach, gate is moved in to next place.



Cornstalk

IT OCCURS only occasionally and no control measures have been successful so far. It is important to be able to distinguish it from nitrate poisoning which it resembles. ♦ Your veterinary has a remedy for nitrate poisoning ♦ ♦

By O. E. OLSON and E. I. WHITEHEAD

FOR A LONG TIME it has been known that cattle deaths occur occasionally in fields of picked corn. The first published report of these losses was made in 1871, and during the next 40 years a number of field and experimental observations were published. However, the questions of cause, prevention and remedy remained unanswered. For a period of time following 1910, this problem did not receive much attention. Then interest in it was revived, and late in 1942 the South Dakota Agricultural Experiment Station began work on cornstalk poisoning.

Cornstalk poisoning (or cornstalk disease, as it was originally called) of cattle generally occurs only occasionally and in isolated cases. This makes its study very difficult, since it is usually impossible to get to the scene of the poisoning in time to make the desired observations. To add to the difficulties, attempts to

produce experimental poisoning of animals by feeding corn stalks hauled in to the laboratory from fields where deaths have occurred have not been successful.

However, some additional information is gained from each occurrence of cornstalk poisoning called to the attention of this laboratory, and this information, together with that gained through continuous experimental work on the corn plant itself, may in time yield effective control measures.

Cause Not Known

A number of theories have been advanced to explain the occasional poisonous nature of cornstalks. Some of the early workers thought that the animals died as a result of overeating of indigestible, fibrous material ("dry murrain"). Others thought that the animals were lacking in salt or water. Excessive consumption of smut, chinch bug infestation, the presence of disease organisms on the corn stalks and cyanide poisoning were also considered at different times as possible causes. However, these explanations have been shown to be incorrect, either by observation or by experimental work.

At the present time it is thought that cornstalks causing death in cattle contain a poisonous substance. What the poison is, and why it is present in lethal amounts in only certain fields, has not yet been established. Indeed, it is possible that more than one poisonous substance

Poisoning

may occur in cornstalks. It is known that certain plants that are high in nitrates can cause death when they are eaten by cattle (see Farm and Home Research, Vol. 1, No. 1, page 3, and Bulletin 424).

Nitrates were first suggested as the cause for cornstalk poisoning in 1895 by workers at the Kansas Agricultural Experiment Station. In recent years, cattle losses have occurred in South Dakota on corn fields where nitrates were found high enough to cause death. It appears quite certain, therefore, that some cases of cornstalk poisoning are caused by nitrates. However, it is also known that several cases of cornstalk poisoning have occurred where nitrates could not be implicated as a cause. Thus, unknown poisonous substances may also accumulate on or in corn stalks under certain conditions. Further work is necessary, however, to establish this.

What Are the Symptoms?

Symptoms of cornstalk poisoning have been observed by several workers. They may be summarized as follows:

Symptoms appear rapidly.

Affected animal often stands apart from the herd.

Nervousness, trembling and muscular spasm may develop.

Labored and rapid breathing.

Animal may become delirious and attack attendants.

Death, if it occurs, usually fol-

lows onset of symptoms within 24 hours.

One important symptom not listed above concerns the color of the blood. All of the above symptoms might be observed in nitrate poisoning, but if the color of the blood is normal and if the nose, tongue and whites of the eyes are not more bluish in color than normal, then nitrates are not involved and the toxic symptoms are the result of an unknown poisonous substance.

If, however, the blood is abnormally dark in color and the nose, tongue and whites of the eyes are excessively blue, it is very probable that nitrates are involved. This distinction is very important, since remedies for nitrate poisoning are known and may be successfully used by veterinarians, but where nitrates are not involved these remedies are apparently of no help.

Control Measures

Because the cause or causes of cornstalk poisoning have not yet been established, it is not possible to recommend good control measures. Where corn is grown on soils suspected of having a high nitrate content (following green manuring or heavy nitrate fertilization, and especially where drought or other conditions have adversely affected growth), the stalks should probably be examined for their content of nitrates prior to pasturing. This measure may prevent losses in some cases, but it is certainly not insur-

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Rust . . . IS CHEMICAL

By GEORGE SEMENIUK

IS THERE a possibility that rust can be controlled by spraying grain fields with chemicals?

We do not know the answer yet, but together with plant pathologists in several neighboring grain-producing states and in other countries, we are trying to find out whether such a practice is feasible. We believe some such method should be devised to help control rust at a time like the present when rust resistant varieties of grain are plagued with dangerous new strains of rust, and when several years are required to develop and release new rust resistant varieties.

High hopes are held for discovering a suitable chemical which, when applied once to the plant, would be taken up by it and would endow the plant with resistance to all races of rust throughout the season. There are some indications that this is possible.

We are quite a ways from having the perfect chemical—or a group of chemicals—that would do the job effectively and economically in a single application and over a wide range of environmental conditions. Our experiments, and those of others to date, have been largely confined to field application of standard organic and inorganic fungicides used in fruit or vegetable spraying and in seed treatment, and to an occasional chemical used as a weed killer.

Our list of chemicals is being enlarged as the weaknesses of the

CONTROL A POSSIBILITY?

tested chemicals are revealed. Here are some of the results obtained under greenhouse and field plot experiments conducted by the Plant Pathology department.

1951 Results on Wheat, Oats and Barley

In 1951, 10 chemicals were applied to late-planted wheat, oats, and barley, beginning on July 12 when the plants were in the boot stage and repeated on July 19 and 30. The average amount of rust and other leaf diseases developing on the plants and the average yield of grain, figured on an acre basis, are shown in Figures 1 and 2.

The names of the chemicals and the rates they were applied are indicated in Table 1 and, except for ammonium sulfamate, were applied at the rates normally recommended by the manufacturer for other plants. Ammonium sulfamate was

What We Have Found Out

1. Yes, there is a possibility that rust can be controlled by spraying with chemicals. However, results are not conclusive enough yet to justify recommendations.
2. Our experiments, so far, have been confined to applications of the standard fungicides ordinarily used in fruit and vegetable spraying, or in seed treatment, and to chemicals used as weed killers.
3. The most promising results have been obtained by spraying with calcium sulfamate. This increased yields and bushel weights of wheat in susceptible and moderately susceptible varieties, but depressed yields slightly in resistant varieties.
4. Many details need to be worked out in the use of calcium sulfamate—the dosages to be used under different climates, the timing and frequency of application, and differences in reaction of the various varieties of grain.

Left: Stem rust on wheat, and below how it affects the grain. Note shriveled kernels of rust infected wheat. Pictures courtesy Rust Prevention Association, Minneapolis.



Table 1. Chemicals Used in 1951

| Trade Name | Rate per 100 Gals of Water | Chemical and Source |
|------------------|----------------------------|---|
| Sulfuron | 6 lbs. | 97% Wettable sulfur, Dupont Co. |
| Phygon XL | 1 lb. | 50% 2,3-dichloro-1, 4-naphthoquinone, U. S. Rubber Co. |
| Yellow cuprocide | 1½ lbs. | 90% Yellow cuprous oxide, Rohm and Haas Co. |
| Parzate | 2 lbs. | 65% Zinc ethylene bis dithiocarbamate, Dupont Co. |
| Zerlate | 2 lbs. | 76% Zinc dimethyl dithiocarbamate, Dupont Co. |
| Fermate | 2 lbs. | 76% Ferric dimethyl dithiocarbamate, Dupont Co. |
| Manzate | 1½ lbs. | 100% Manganese ethylene bis dithiocarbamate, Dupont Co. |
| Orthocide 406 | 2 lbs. | 50% N-trichloromethylthio tetrahydrophthalimide, California Spray Co. |
| F 1003 | 2 qts. | Disodium-1, 2-propylene bis dithiocarbamate, Dow Chemical Co. |
| Ammate | 3 lbs. | 80% Ammonium sulfamate, Dupont Co. |

applied at about one-twentieth the strength recommended as a weed killer, but it was applied only once because the one application injured the plants.

Parzate Reduced Rust on Wheat and Oats

Of the chemicals tried, Parzate seemed most consistent in reducing rust on wheat and oats and leaf spot on barley, and at the same time increasing yields of these grains. The effectiveness of the other chemicals varied according to the type of grain and the variety. Manzate, Fermate and Zerlate were less effective than Parzate. Ammate (ammonium sulfamate) reduced rust on wheat and oats but injured the plants and reduced yields considerably.

1952 Results

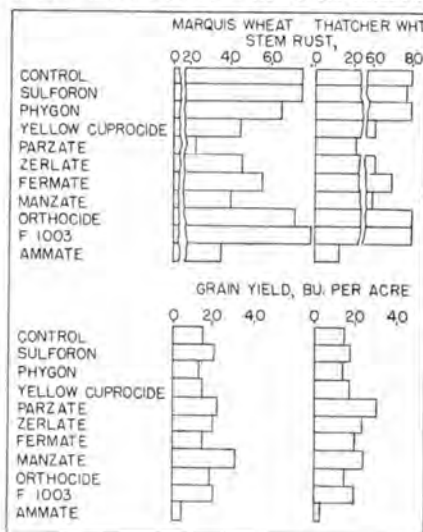
In 1952, 12 chemicals were applied in weaker strengths than in 1951 and to the same two varieties

of wheat, oats and barley, but the concentration of these chemicals apparently was too weak to be effective.¹

1953 Results Point to Sulfamates as Offering Promise

In 1953, two tests were conducted. In one, 11 chemicals² were applied to Mida wheat, Brunker oats, and Montcalm barley, and in the

Fig. 1. Wheat yields per acre and percent of rust when treated with 10 chemicals.



¹The chemicals were *o*-toluenesulfonylamide, *p*-toluenesulfonylamide, *p*-aminobenzenesulfonylamide, *n*-naphthol, chloramine T, sodium *o*-benzoic sulfonamide, Phygon, Orthicide 75, Dithane D14, Manzate, maleic hydrazide formulation 30 and pure maleic hydrazide. The strengths of these were 0.001 molar of the effective agent. By molar is meant a quantity in grams in one liter of water equal to the molecular weight of the material.

other, two chemicals³ were applied in similar concentrations to nine varieties of spring wheat differing in rust resistance. In both tests, the solutions or suspensions were applied at the rate of approximately 100 gallons per acre on June 11 when the plants were about one foot tall and when a light amount of stem rust was present on wheat. (High rates such as this are used only in experimental work and not under ordinary field conditions.) They were applied at the rate of approximately 200 gallons per acre once or twice thereafter at one- or two-week intervals.

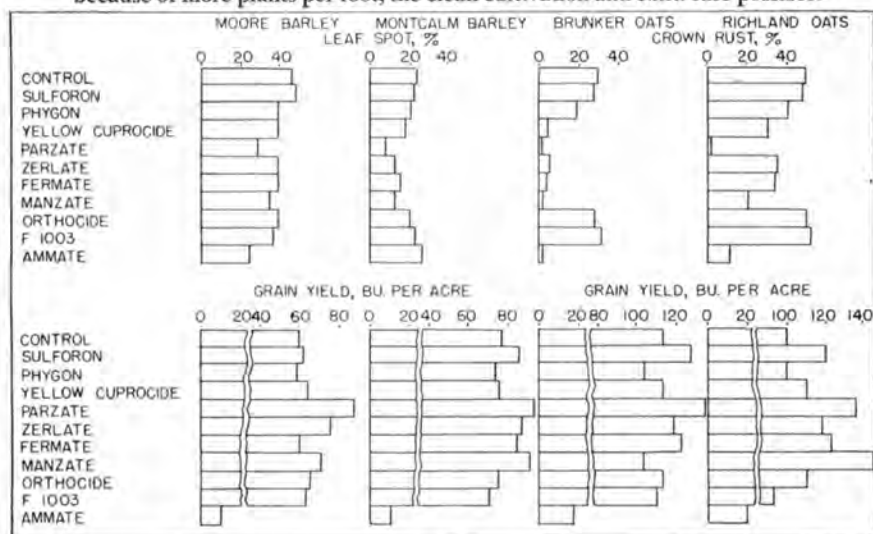
Two applications were made in

the first test, arranged so that certain plots received the chemicals on June 11 and 18 and others on June 11 and 26. The June 26 application was at a time when the oats were beginning to head and the wheat and barley were still shooting. Stem rust did not develop on the oats until early July and on barley until late July.

Time of Spraying Important

Of the 11 chemicals tried in the first test using two applications, the ammonium, sodium and calcium sulfamates in 0.05 molar concentration were the only fungicides that controlled rust to some extent in wheat and oats, but not in barley where stem rust developed late in the season. Better control of rust was obtained in wheat when the two applications were spaced two weeks apart than when they were spaced one week apart, while the reverse situation occurred in oats.

Fig. 2. Percent of rust and leaf disease on barley and oats and average yield per acre when treated with 10 chemicals. Field plot yields usually run higher than farm yields because of more plants per foot, the clean cultivation and extra care possible.



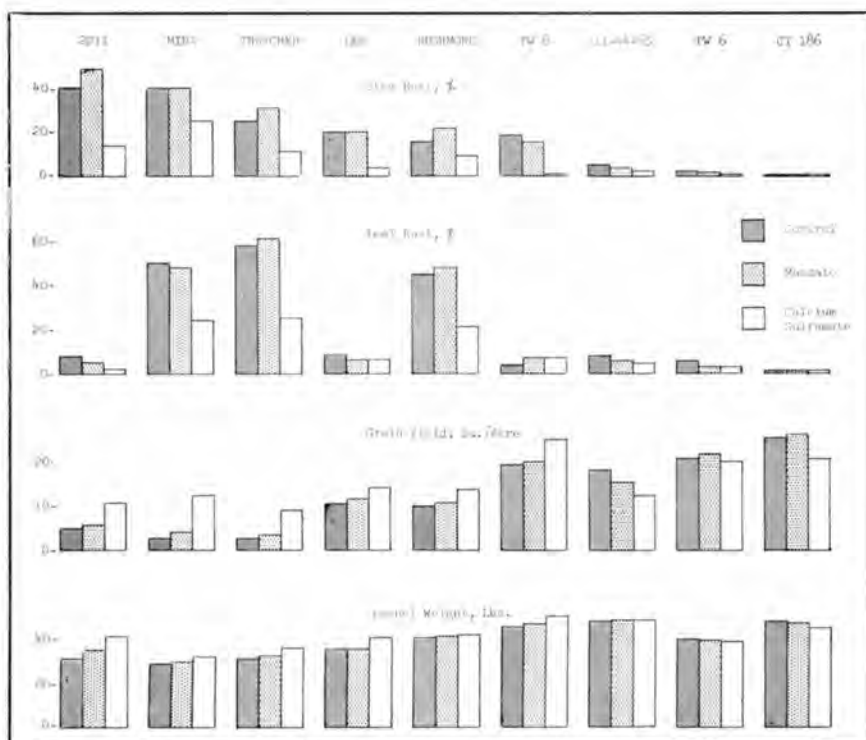


Fig. 3. Two chemicals (Manzate and calcium sulfamate) applied to 9 varieties of wheat.

The yield and bushel weight of oats was reduced by the sulfamate sprays. The damage consisted of the failure of seeds to fill properly. The injury was greater when the chemicals were applied June 11 and 18, than when applied June 11 and 26.

Phygon appeared to control rust in wheat and to increase slightly the yields and bushel weight of this crop when applied June 11 and 18. Maleic hydrazide in 0.02 molar concentration caused burning of wheat, oats and barley when applied twice on June 11 and 18, but was less injurious to these crops when applied only once on June 11. Maleic hydrazide injured the barley and oats less than the wheat.

Grains Differ in Response

In the second test in 1953 (where two chemicals were applied three times on June 11, 18, and 26 to nine varieties of wheat), calcium sulfamate controlled rust most on the very susceptible varieties, No. 2211, Mida, Thatcher and Lee; moderately on the moderately susceptible varieties, Rushmore and PW 8, and not at all on the resistant varieties, PW 36, No. 11-44-65 and CT 186 (See Fig. 3). Manzate proved relatively ineffective in controlling rust.

Calcium sulfamate increased yields and bushel weights of grain in susceptible and in moderately susceptible varieties, but it de-

Continued on page 21

Financing of Cooperatives

The Cooperative is a part of the farm enterprise and its financing methods of interest to farmers

By OTTAR NERVIK and R. GUNDERSON

THE INCREASE in business activity in the last 15 years has had a great influence on the operation of farmer cooperatives. From 1939 to 1949 their total dollar volume of business in the United States increased four times. Membership doubled, although the number of associations declined slightly (Table 1).

An important factor in this expansion in the dollar volume of business has been a rising level of prices. Other factors which have contribut-

ed are the increases in farm production and the trend towards use of more machinery, gas and oil, more fertilizer and the greater use of prepared feeds.

For instance, in 1939 the total expenditures for farm supplies in the United States was \$3,217 million. In 1951 this had increased to \$14,735 million. If these figures are adjusted for changes in the price level, the total expenditures for farm supplies about doubled in this period.

This expansion in business vol-

Sam Jensen and Ed Wacker, neighbors from Lake Preston, S. D., talking over some of the details of the financing of cooperatives, a subject of interest to most farmers.

Picture courtesy of Farmers Union Grain Terminal Association



Table 1. Number, Membership, and Volume of Business of Farmers' Cooperatives in United States, 1939 and 1949

| | Marketing Associations | | Purchasing Associations | | Total | |
|---|------------------------|-------|-------------------------|-------|--------|--------|
| | 1939 | 1949 | 1939 | 1949 | 1939 | 1949 |
| Associations listed | 8,051 | 6,922 | 2,649 | 3,113 | 10,700 | 10,035 |
| Estimated membership in thousands | 2,300 | 4,075 | 900 | 2,509 | 3,200 | 6,584 |
| Estimated business in millions of dollars | 1,729 | 7,083 | 358 | 1,643 | 2,087 | 8,726 |

Source: *Agricultural Statistics, 1951*, USDA, Washington, D. C., 1951, Table 654, p. 568.

ume has made great demands on the capital resources of cooperative associations. More capital is needed for maintaining and expanding buildings and other facilities, and more capital is needed in the daily operations. For instance, cooperatives now generally carry larger physical volumes of inventories, and at the same time the prices of those inventories have increased greatly.

Financing Methods Surveyed

Since a cooperative is an extension of the farm enterprise, it was believed to be of value to study the financing methods of the cooperative associations, and also to obtain the opinions of members as to the problems involved in cooperative financing. For this reason, two surveys were conducted: (1) a survey of cooperative associations, and (2) a survey of the members. All information was collected by personal interviews with managers and members.

In this preliminary report, the plan was to give (1) an indication of the expansion in business volume of South Dakota cooperatives, (2) how this expansion has affected their capital requirements, (3) the methods they have used in obtaining funds, and (4) the preferences of the members regarding the financing methods.

Large Increase in Business Volume

The average volume of business for each type of cooperative in 1951 was compared to the volume reported in a previous South Dakota study covering the year 1936. For example, the average business volume of elevators was about 10 times as large in the 1951 study as in the 1936 study. Oil stations had increased their average volume more than four times. Creameries also showed a great increase in volume of business (Table 2).

In examining this table, certain factors should be recognized, 1936 was a very poor crop year in South Dakota, and the volume handled by grain elevators was probably lower than average. In addition, many cooperative elevator associations since that time have gone into other lines of business, such as petroleum products, tires and tubes, and lumber products. Cooperative oil stations were a relatively new development in 1936, and a great increase in farm consumption of petroleum products has occurred since then.

More Capital Needed

The relationship between the increase in volume of business and capital requirements was examined by comparing the value of fixed assets, working capital, and inventories in 1939 and in 1951. Data for

Table 2. Average Dollar Volume of Business Handled by South Dakota Cooperatives, 1936 and 1951

| Type of Association | Average Purchasing | | Average Marketing | | Average | Total |
|---------------------|--------------------|----------|-------------------|---------|---------|---------|
| | 1936 | 1951 | 1936 | 1951 | 1936 | 1951 |
| Elevator | 18,460 | 110,995* | 44,592 | 554,108 | 63,052 | 638,464 |
| Oil | 49,624 | 218,801 | 36 | 0 | 49,660 | 218,801 |
| Creamery† | 1,669 | | 139,087 | | 140,756 | 496,719 |

*Only 19 elevators indicated any purchasing.

†Only one reported any purchasing.

this comparison were obtained in the survey, 1939 being selected as a representative year of the prewar period.

The average value of fixed assets (original costs minus depreciation) was three to five times higher in 1951 than in 1939. Average working capital tripled, and inventory values also showed a great increase in all types of cooperatives (Tables 3).

How Are Cooperatives Financed?

Cooperatives, in general, obtain most of their funds from members and patrons. This was true of the cooperatives in this study. However, the investment per member was relatively low, being \$226 for elevators, \$166 for oil stations, and \$97 for creameries. Only part of this represented a cash investment by the members. The rest of the member investment is represented by deferred patronage refunds, or as they are popularly called, patronage dividends.

Most cooperatives keep at least part of their savings to finance their

operations. These savings are allocated to members and in most cases will eventually be paid to them. In some cooperatives, capital stock credits are issued for these refunds; in other cooperatives, various ways of handling them are found. Stock credits were most commonly used in oil cooperatives (Table 4).

Surprisingly few of the cooperatives had any borrowed funds at the end of the fiscal year. Twelve elevators, 13 oil stations, and 7 creameries reported no borrowed funds.

Borrowed funds at the end of the year do not always reflect the cooperative's need for borrowed capital. The grain elevators, in particular, have a volume of business which fluctuates with the season. During harvesting time they need a great amount of borrowed capital to carry their inventories. Therefore, the managers were asked what was their maximum amount of loans during the year. In addition, they were asked what the normal amount was. The maximum was about twice the amount outstanding at the end

Table 3. Average Fixed Assets, Average Working Capital, and Average Inventories in South Dakota Cooperatives, 1939 and 1951

| Type of Association | Average Fixed Assets (Depreciated Values) | | Average Working Capital | | Average Inventories | |
|---------------------|--|--------|----------------------------|--------|---------------------|---------|
| | 1939 | 1951 | 1939 | 1951 | 1939 | 1951 |
| Elevator | 10,930 | 52,500 | 13,540 | 49,610 | 20,380 | 113,630 |
| Oil | 7,680 | 40,420 | 15,460 | 54,400 | 6,100 | 32,000 |
| Creamery | 10,310 | 33,700 | 11,790 | 36,200 | 6,240 | 17,860 |

Table 4. Average Investment per Member by Type of Cooperative

| Type of Cooperative | Common Stock | Preferred Stock | Part Paid Shares | Deferred Patronage Refunds | Allocated Reserves | Unallocated Reserves Surpluses | Total |
|---------------------|--------------|-----------------|------------------|----------------------------|--------------------|--------------------------------|----------|
| Elevator — | \$ 61.47 | \$2.90 | \$17.79 | \$65.93 | \$36.75 | \$41.37 | \$226.21 |
| Oil ——— | 112.70 | 1.88 | 2.90 | 16.31 | 7.71 | 24.94 | 166.43 |
| Creamery — | 17.46 | — | 3.04 | 18.55 | 16.31 | 41.87 | 97.24 |

of the year for elevators, and it was slightly higher for oil stations. The normal amount corresponded fairly closely to the loans at the end of the year in creameries (Table 5).

Need for Permanent Capital

An important factor in the capital structure of business organizations is the relationship between permanent and temporary capital. Permanent capital includes funds which will be left in the organization for a long period of time. Examples of this type of capital are stock and long-term bonds. Temporary capital includes funds which can be used by the firm but which can be called for payment on relatively short notice. Most bank loans are this type.

This raises a special problem for cooperatives in connection with their deferred patronage refunds. Should these be considered permanent or temporary capital? Usually they are supposed to be paid out sometime in the not too distant future; consequently it is doubtful

whether they should be included in the permanent capital.

The permanent capital should be at least sufficient to cover the fixed assets. It was found that the majority of the cooperatives in the study had sufficient permanent capital to cover their fixed assets; but of the 55 from which completed records were obtained, 14 had insufficient permanent capital to do this.

Members Prefer Financing by Deferring Patronage Refunds

Since members carry most of the burden of financing cooperatives, it is important that they approve of the methods used in obtaining funds. For this purpose a group of members were asked whether they had any objection to methods used by their cooperatives. Eighty-eight percent answered no to this question. However, some of these said they would like to receive some cash refunds. Members have to pay income tax when patronage refunds are allocated to them by the cooper-

Table 5. Total Amount of Loans Needed During the Fiscal Year by Type of Cooperative, Maximum and Normal*

| Type of Association | Total Amount at End of Fiscal Year | Maximum Amount Needed During Peak Season | Normal Amount Needed During Year |
|---------------------|------------------------------------|--|----------------------------------|
| Elevator ——— | \$525,610.62 | \$993,300.00 | \$560,800.00 |
| Oil ——— | 124,982.76 | 162,200.00 | 128,850.00 |
| Creamery† ——— | 39,689.12 | 50,000.00 | 33,000.00 |

*Thirteen elevator, 12 oil, and 3 creamery associations reported borrowed funds.

†Does not include one creamery association which had a large loan at the end of the fiscal year, but did not indicate maximum and normal amounts.

ative regardless of whether they receive any cash payment or not.

The members were asked to rank methods of financing in order of preference. The great majority, about two-thirds, listed deferred patronage as their first choice.

Participation of Members

An important element in financing cooperatives is that members feel that the decision is taken by them, and not by the manager and board of directors alone. This is particularly true when the cooperative obtains funds from members by deferring patronage refunds. Deferring of refunds is a decision to reinvest their capital, and this decision should be taken by them.

The members were asked whether they had an opportunity to vote on distribution of savings. Fifty-nine percent felt they had, but 24 percent did not feel they had such an opportunity. Another 17 percent had no opinion. Only 34 percent reported that they voted during the preceding year, while 60 percent did not vote in the cooperative.

Forty-nine percent felt that these decisions were taken by the board of directors, and only 27 percent felt that it was the members who made the decision; 24 percent did not know who decided. Some reported that according to the by-laws such decisions are taken by the board.

Most of the managers of cooperatives (71 percent) reported that such decisions were taken by the board of directors. Apparently both members and directors agree that these decisions are taken by the board. There are of course different interpretations of the term "making

the decision," but the study certainly indicates that members do not feel they have the deciding voice.

There is a basic conflict between manager, board of directors, and members about policy making. The manager and the board of directors often feel that they are in a better position to know what policies should be followed. Usually this is true. It should never be forgotten that the cooperative belongs to the members and that the final responsibility should be theirs. Management should make all possible efforts to explain the facts and the possible consequences of particular policies, and then let the members decide.

Improvement of Relations

Cooperatives have an increasing need for capital. However, members have not made the cash investment necessary to provide the necessary business expansion. For this reason, cooperatives have been forced to finance their operations to a large extent by deferring patronage refunds or dividends. There is often a lack of planning of the financial aspects of the enterprise, which have left some cooperatives with insufficient permanent capital. This may cause difficulties if savings fall off.

There is a need for better relations with members. Often members do not know the business problems of their cooperative, and they sometimes feel that they have no voice in decisions taken by management. Improving membership relations is one of the more urgent needs of cooperatives. (Project 231. Leader: Ottar Nervik, Agricultural Economics Dept.)

A Trench Silo

Continued from page 7

The gates have just been put in place and the silo opened for self-feeding. One half of the silo has been filled with long grass silage and one half with field chopped silage. Thus, a comparison of the value of each can be made. As the silo was opened there appeared to be considerable spoilage of the baled long grass silage, but only a few inches of spoilage on the chopped material.

The structure has been covered with a rubber-like blanket called

vinyl-film, so that surface spoilage can be compared with other uncovered temporary stack silos. Silage quality samples have not yet been taken. No floor was placed in the silo this year, but a concrete slab will be poured next year.

Other types of storage included in this study are a glass-lined steel upright silo, permanent upright silos, a trench silo, and temporary stacks. (Project 237. Leader: G. C. Zoerb. Agricultural Engineering Dept.)

Cornstalk Poisoning

Continued from page 9

ance against all losses from cornstalk poisoning.

The only other practical control measure, one which will not prevent losses but may reduce them, consists of removing cattle from cornfields immediately when any symptoms of distress are observed. A local veterinarian should be contacted in order to definitely establish that cornstalk poisoning, and not some infectious disease, is involved, and because, if the symptoms of nitrate poisoning are recognized, it may be possible for him to treat the cattle in time to prevent losses.

In some instances it has been observed that after a few weeks, cornfields which previously caused poisoning are no longer toxic. The factors involved in this loss in toxicity are not known, and repasturing of corn fields where losses have occurred should be practiced only when necessary and with careful

and frequent observation of the cattle.

Are Others Animals Affected?

Although almost all cases of cornstalk poisoning that have been reported have occurred in cattle, it has not been definitely established that sheep and horses are not susceptible to it. Where nitrates are involved, they may certainly be susceptible. Fields where cattle losses have occurred should not, therefore, be considered safe for sheep and horses.

Hogs have not been reported to be poisoned on these fields, but this may be because "hogging down" generally precedes grazing and the corn ears are not believed to be involved in cornstalk poisoning. (Project 130. Leaders: O. E. Olson and E. I. Whitehead, Station Biochemistry; G. S. Harshfield, Veterinary Dept.; C. M. Nagel, Plant Pathology Dept.)

Rust--Chemical Control?

pressed yields slightly in resistant varieties. Manzate increased yields of grain in some very susceptible varieties even though it did not appear to reduce rust development. On the basis of these results, calcium sulfamate in the strengths used appeared to depress grain yields, but the depression was masked in the very susceptible varieties where yield increases resulted from rust control.

Greenhouse Results

Greenhouse tests in April and May 1953 were conducted on Brunner oat seedlings by immersing the foliage for 10 minutes in solutions or suspensions of various fungicides, and, after three days, washing the foliage in running water and immediately dusting them with spores of stem rust. In these trials the sulfamate compounds, Dithane D-14, Manzate, Zerlate, Fermate, Phygon, Orthocide 406 and Vancide 51 showed promise as effective fungicides at 0.01 or 0.05 molar strengths in controlling rust.

Present Outlook

Recent reports from adjoining states of effective field control of rust from calcium sulfamate, Phygon, Manzate, and chemicals related to the latter, suggest the likely possibility of controlling rust by chemical means. However, the results from most of these have not

Continued from page 14

been so promising as from calcium sulfamate.

Dr. J. E. Livingston, plant pathologist of the University of Nebraska, has reported good rust control and yield improvement in wheat in the field from calcium sulfamate applied in Nebraska and Mexico, either from a ground sprayer or an airplane. However, the favorable results obtained by him have not been comparable or so consistent in other states. Serious injuries have resulted to the grains in some states, and in others only fair controls have been obtained with but slight injuries.

Climatic differences presumably have much to do with the results. There are many details in the use of calcium sulfamate that need working out, particularly those that relate to the dosages to be used under different climates, to the timing and frequency of application and to the type and variety of grain to be sprayed.

Meanwhile we are searching for more effective chemicals that will be less influenced by such variable conditions as weather, and will require only one low gallonage application from an airplane to protect the plants during the remainder of the season. (Project 204. Leaders: George Semeniuk, Plant Pathology Dept.; J. T. Slykhuys, formerly of the Plant Pathology Dept.)





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At low temperatures SD104 has a high percent of vigorous seedlings. SD107 fails to emerge or has weak plants.

Response of the two single crosses to low temperatures. Mother plant appears to influence the way seed germinates.



GETTING A GOOD STAND OF CORN

... in spite of the weather

D. B. SHANK and G. E. NACHTIGAL

OBTAINING A GOOD STAND of corn in a cold, wet spring is a problem often faced by South Dakota farmers. When the early part of the growing season is chilly and wet, corn plants are more vulnerable to attack by soil borne diseases because of a slowing up of the growth of the young seedlings. In addition to the cold soil, other factors such as seed coat injury, age of seed, maturity of seed when harvested, lack of soil aeration, and hereditary differences among different hybrids may contribute to slow germination and weak seedlings, which are then vulnerable to seedling diseases.

To produce corn which will mature fully before frost in the relatively short South Dakota growing seasons, hybrids must be developed that will germinate rapidly and grow vigorously in the seedling stages. Therefore, a study was undertaken on two inbred lines, one of

which, SD104, usually produces a good stand every year, while the other, SD107, fails to come up unless sound, mature seed is used and the soil is warm. Comparisons on the germination abilities of the two inbreds under low temperatures were made and the differences were studied in relation to differences found in the development of the seed kernel.

How Tests Were Conducted

Hand-pollinated seed was produced, by selfing each inbred line, and by making the two single crosses (SD104 x SD107) and (SD107 x SD104). The two inbreds are of different maturities. Therefore, they were planted at different dates so that all pollinations could be made at the same time. Ears were harvested at periodic intervals after the pollinations in order to obtain seed at various stages of development, since this is what happens in a seed

field when an early frost stops growth before the corn is ripe.

Samples for moisture determinations were taken from each ear when it was harvested and then the rest of the ear was carefully air dried. Each ear was then shelled separately. The kernels were treated with Arasan dust to reduce disease growth on the kernel itself, after which replicated samples were planted in greenhouse flats containing field soil.

After saturating the soil with water, the flats were placed in a 45 to 50° Fahrenheit cold chamber for 14 days. Following the "cold soil" treatment the flats were placed in a warm room for the rest of the germination period. Since at low temperatures corn seedlings grow very slowly, but soil organisms will still function, this allowed diseases to attack the young seedlings while their growth was being held back. This is what happens so often in the field. In a warm spring the same diseases are prevalent, but the corn grows so fast that they often do not cause much damage.

Cold germination tests on breeding material. Each row in each flat represents a different progeny. Some do not emerge.



To try to explain why germination differences might exist, moisture percentages on the seed when it was harvested and endosperm (starchy part of the kernel) and embryo weights were determined.

Large Differences in Germination Found

The two inbred lines behaved as expected when germinated in the cold soil, SD104 having a high percentage of vigorously growing seedlings, while SD107 either failed to emerge or had only a few very weak plants (Table 1). This was especially true for seed harvested while still immature. Seed of SD107 which was more mature (later harvests) came up better but was never able to produce as good a stand as that given by SD104, indicating that SD107 is inherently weak under adverse conditions.

Immature seed of the single cross (SD104 x SD107) acted like its maternal parent SD104 by emerging well, while the reciprocal cross (SD107 x SD104) likewise followed its maternal parent, SD107, in germination ability. Apparently the mother plant influences the way its seed will germinate. When more mature seed was harvested only small differences existed between the two hybrids.

Degree of Maturity May Cause Cold Germination Differences

The maturity of corn is related to the amount of moisture in the kernel. Roasting ears have about 65 to 75 percent moisture, early dent about 55 percent. When the kernels reach 35 to 40 percent moisture, no more starch is deposited in the ker-

Table 1. Effect of Time of Harvest on the Average Moisture Content, Endosperm and Embryo Weights, and Normal and Cold Germination, 1950

| Variety | Days from Pollination to Harvest | Kernel Moisture Percent* | Endosperm Weight Mgm. | Embryo Weight Mgm. | Normal Germination Percent | Cold Germination Percent |
|-----------|----------------------------------|--------------------------|-----------------------|--------------------|----------------------------|--------------------------|
| SD104 | 23 | — | 62 | 5.2 | 54.8 | 27.2 |
| SD107 | 23 | 78.1 | 47 | 3.0 | 21.6 | 00.0 |
| 104 x 107 | 23 | 69.7 | 50 | 5.3 | 79.2 | 46.4 |
| 107 x 104 | 23 | 76.6 | 63 | 4.9 | 42.8 | 22.0 |
| SD104 | 28 | — | 91 | 9.8 | 73.6 | 52.4 |
| SD107 | 28 | 72.0 | 79 | 5.9 | 38.4 | 21.6 |
| 104 x 107 | 28 | 63.6 | 88 | 9.9 | 78.4 | 57.2 |
| 107 x 104 | 28 | 69.9 | 91 | 8.4 | 71.2 | 43.2 |
| SD104 | 35 | — | 124 | 13.2 | 77.2 | 56.4 |
| SD107 | 35 | 64.9 | 108 | 9.3 | 79.2 | 41.6 |
| 104 x 107 | 35 | 56.5 | 123 | 14.0 | 84.0 | 67.6 |
| 107 x 104 | 35 | 63.0 | 130 | 12.8 | 79.6 | 59.6 |
| SD104 | 42 | — | 162 | 18.7 | 82.0 | 74.0 |
| SD107 | 42 | — | 154 | 15.6 | 87.2 | 57.6 |
| 104 x 107 | 42 | — | 158 | 19.8 | 90.4 | 87.6 |
| 107 x 104 | 42 | — | 172 | 18.0 | 87.2 | 74.4 |

*Not available in 1950 so 1951 figures used.

nels and they are considered mature, even though the corn is not dry enough to crib.

It was found in this study that, when harvested at the same intervals after pollination, inbred SD107 and the single cross (SD107 x SD104) contained considerably more moisture in the kernels than did the single cross (SD104 x SD107). The high kernel moisture of SD107 and of the single cross where it was the maternal parent indicate that they were less mature than the cold resistant varieties at comparable harvest periods. This may well account for the germination differences found.

Effect of Endosperm and Embryo Weight

From Table 1 it is apparent that the inbred SD107 possessed the

lightest embryo and germinated the poorest. The single cross (SD107 x SD104) has a heavier embryo than its maternal parent (SD107), and considerably better germination. In the other single cross (SD104 x SD107), the hybrid showed a slight advantage over its maternal parent (SD104) in embryo weight and a distinct advantage in germination, especially in the less mature stages. Apparently, embryo weight will have some effect on germination in cold, wet soils, particularly when seed must be harvested before it is completely mature.

The endosperm weight of the single cross (SD107 x SD104) was heavier than that of its reciprocal cross (SD104 x SD107) at all harvests. Yet the latter always had a higher germination under cold, wet

Continued on page 30

Alfalfa DISEASE PROBLEMS



Fig. 1. Alfalfa wilt. Plants dug from the field in September show a normal plant on the left, a moderately diseased plant (middle) and a nearly dead plant on the right.

G. SEMENIUK and M. W. ADAMS

ALFALFA diseases in South Dakota each year cause an estimated 10 to 25 percent loss in the potential value of this crop, which is in addition to that caused by insects or by poor weather and soil conditions. Chiefly responsible for these diseases are fungi and bacteria, although viruses and nematodes (worms) are also involved. Poor seedling stands, the thinning out of mature plant stands, unthrifty plants, leaf drop and lower yield and quality of seed are the noticeable results. These diseases are widespread over the state but their seriousness varies with weather and soil conditions, with some becoming more damaging under droughty than under more humid conditions.

Except for one disease, alfalfa wilt, there is no appreciable resistance to these diseases in present varieties, as such varieties were introduced or developed largely for their winterhardiness. Now that alfalfa growing is

Fig. 2. Blackstem, represented by the darkened area on the main stem and side branches, caused by fungus *Ascochyta imperfecta*.



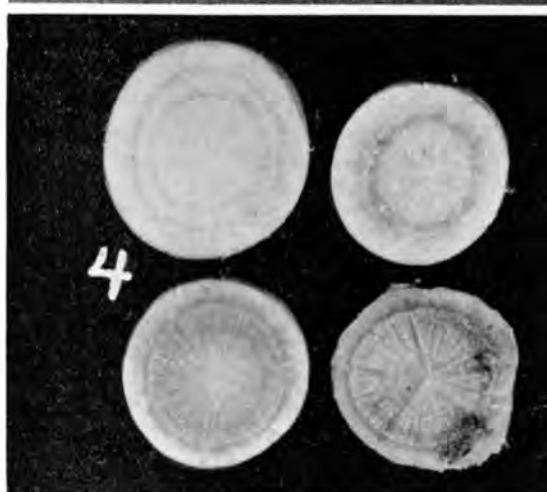
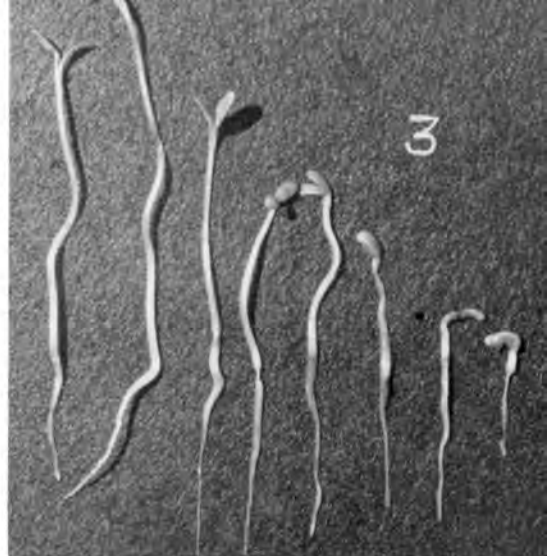
IN SOUTH DAKOTA

regaining its place in the agriculture of the state, there is need for correcting or compensating for the disease susceptible qualities of our varieties: (1) to improve the yield and quality of forage and seed, (2) to reduce drought effects, (3) to extend alfalfa growing to drier areas, and (4) to equalize production between years and between seasons within a year. The Agricultural Experiment Station through the Plant Pathology and Agronomy departments has recently undertaken such a program to meet this need.

Thin Seedling Stands

Seed or seedling rot, (Fig. 3) often called damping-off, and caused by several soil-inhabiting species of fungi, is frequently responsible for thin seedling stands. (Sometimes thought to be the result of poor seed-bed preparation or dry weather). Soils differ in the extent to which this disease develops, the reason being unknown but sometimes being associated with the soil's acidity or previous cropping history.

Fig. 3. Seedling rot, often called "damping off" and caused by soil inhabiting species of fungi. Fig. 4. Alfalfa wilt. Cross sectional view of alfalfa roots, showing the appearance of a healthy root (upper left) and of the discolored, wilt-diseased roots. Fig. 5. Sections of four alfalfa roots, exposing stages of crown rot development. The two plants on right have rot extending from stubble into crown tissue. The two plants on left show rot advancing still further into the crown of the plant.





Two of the most widespread and persistent leaf diseases responsible for leaf-drop are: Fig. 6 (left) Common leaf spots caused by *Pseudopeziziza medicaginis*,

and Fig. 7 (middle) Yellow leaf blotches caused by *Pseudopeziziza jonesii*. A minor cause for leafdrop is shown in Fig. 8. Leaf spot caused by *Ascochyta imperfecta*

Treating seed with chemicals such as Arasan is a good insurance against this trouble, as in some instances thin stands have been prevented by seed treatment. Usually 10 or 12 pounds of seed per acre compensates for this disease, but such amounts are wasteful of seed and sometimes result in too heavy stands, especially in dry areas. There is much to be learned about this disease before it can be adequately predicted or controlled.

Thinning Out of Mature Plant Stands Under Field Conditions

Alfalfa wilt and crown rot are two diseases responsible for thinned established stands. Alfalfa wilt (Fig. 1) is more frequent in the irrigated fields of the west and in the non-irrigated, more-humid parts of the east than in drier areas. It is caused by a soil-borne bacterium that enters the roots through wounds and develops in the food and water-conducting portions of the roots (Fig. 4) and above-ground stems.

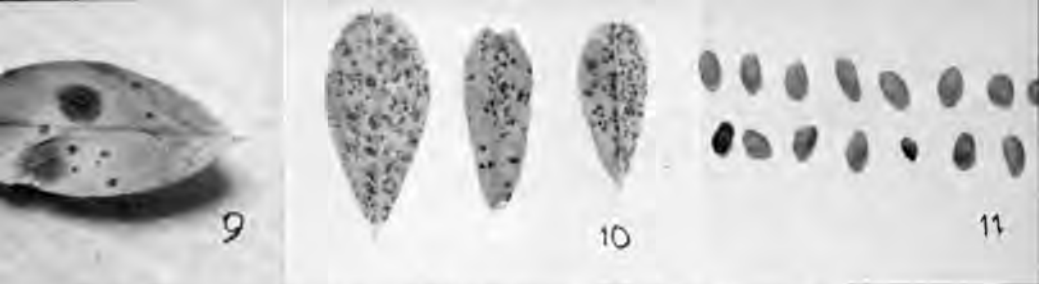
The sickle bar of the mowing machine helps spread this bacterium from plant to plant when the crop is cut for hay, especially when the plants are wet from rain or heavy dew. Ranger is more resistant to this disease than Ladak or Cossack,

while Grimm, South Dakota Common, and most other varieties possess least resistance. Varieties more resistant than Ranger are needed to reduce further the loss from this disease.

Crown rot is widespread over the state with effects on growth and survival that often are more severe under semi-arid conditions. As the name implies, the disease is a rot (Fig. 5) of the ground-level part of the root where stems are attached and where new buds are found. It is caused by several semi-parasitic fungi that enter the crown through wounds or stubble. Under most conditions the disease develops slowly, beginning with the second year, gradually destroying the crown and new shoots, but under certain conditions it may suddenly destroy nearly all plants within an entire field or portion of a field. No way is known to control it.

Unthrifty Plants

Alfalfa wilt and crown rot result in unthrifty plants when these diseases are in the advanced stages of development. In addition, other widespread root troubles occur that contribute even more to unthrifty plants, especially in seasons and areas of limited rainfall. These are



Also a minor cause of leafdrop, which may be important in some years: Fig. 9. (left) Two large leaf spots caused by *Cercospora zebrina*. Fig. 10 (middle) Shows

leaf rust caused by *Uromyces striatus*. Fig. 11. Seed quality and quantity from a single pod as affected by the Blackstem disease (lower) and by no disease (upper).

chiefly in the finer roots, whose effectiveness for supplying water and nutrients to the plant for top growth is reduced or lost. Several soil-inhabiting parasitic fungi are responsible for this result, but little is known of their separate effects, or of how to control them through resistant varieties or modified cultural practices.

Leafdrop

Two of the most widespread and persistent leaf diseases responsible for leafdrop are common leaf spot (Fig. 6) and yellow leaf blotch (Fig. 7), caused by fungi. Leafdrop may reach as high as 50 percent in the second or third crops cut for hay or silage, or nearly 100 percent if the crop is retained longer, or if left for seed.

Other leaf spots shown in Fig. 8 and Fig. 9 occurring in the first or succeeding crops are usually minor causes for leafdrop, but some of them may be important in some years. Leaf rust (Fig. 10) in some years may produce much leafdrop in the second or third crops.

The most extensive leafdrop usually occurs in the humid, eastern part of the state, although surprisingly extensive leafdrop also may occur from yellow leaf blotch in the semi-arid western part of the state.

Such defoliations represent loss of nutrients, as fully one-half of the food value of a crop resides in the leaves produced.

The chief sources of the fungi causing leaf spots, except rust, are the dead leaves on the ground from the preceding year or preceding crop, or the diseased leaves on the plants in the current crop. Usually several years are required for these fungi to build up in a new field, as this depends on the proximity of neighboring fields and on wind transport of their spores.

No current commercial varieties are resistant to leaf spots, although certain small percentages of plants within each variety have some resistance to one or another of them. The evidence on hand from disease studies on individual plants in nurseries at Brookings suggests that a variety may be produced with resistance to these diseases.

Lower Yield and Quality of Seed

Blackstem (Fig. 2), caused by a fungus, is the most important disease affecting the yield and quality of seed, particularly in the humid eastern part of the state. It is considered to be the most important disease factor limiting successful seed production. As implied by the

name, the disease produces a blackening (and early dying) of stems, which may include the seed pods. Frequently, the diseased fine stems supporting the seed pods become brittle and break under wind action, thereby dropping the pods.

The seeds in the pods may become infected, shrivelled and discolored (Fig. 11), many of which become lost in threshing. Discolored seeds and low seed yields of 25 pounds or less per acre are common some years. Such losses usually appear more severe in the first crop left for seed than in the second. No satisfactory control measures are known.

Research Approach

The program of research now underway at the Experiment Station includes (1) a study of the nature, distribution and development of the various diseases affecting alfalfa in the state, and (2) an evaluation of the disease resistant qualities of individual plants in field nurseries and in greenhouse experiments for the purpose of producing disease resistant varieties. The work is being conducted on as broad a basis as present finances and personnel permit to yield fundamental information and practical results. (Project 230. Leader: G. Semeniuk, Plant Pathology Dept.)

Getting a Good Stand

Continued from page 25

conditions, thus showing that the greater food supply available to the young embryo did not mean that it would grow faster and escape injury.

Significance of the Results

These results emphasize that there are inherited differences among inbred lines of corn which are responsible for good stands of vigorous, fast growing seedlings when planted in a cold, wet soil. These differences are retained in the hybrids made from them, especially

when the inbred is used as a female parent.

As a result of such knowledge, breeding material being developed in the Agricultural Experiment Station program is subjected to what are called "Cold Germination Tests." Any new lines being developed will contain the ability to emerge well every spring, because the strains which will not do so are discarded long before they have been developed to the place where they might be used commercially. (Project 66. Leader: D. B. Shank, Agronomy Dept.)

SOUTH DAKOTA HYBRIDS AGAIN IN LEAD

Corn hybrids developed in South Dakota gave top performance again this year in eight out of thirteen test locations in the state. This was in competition with the most popular hybrids grown in the areas where the tests were conducted. They were in the lead in the county tests of Jackson, Hyde, Brown and Brookings, and in Butte and Spink for both dryland and irrigation.

Commercial Expansion

from

Irrigation



Both population and business can be expected to increase as a result of irrigation. New industries, such as alfalfa dehydration plants, sugar beet plants, and canning factories are possibilities under irrigation.

By JOHN THOMPSON

WHO SHOULD REPAY the construction costs of an irrigation development? Shall the farmers pay the *total costs*, or if others benefit from it, should they pay a proportional share?

It is generally agreed by businessmen in agricultural areas that the success of their business operation is largely dependent upon the number and prosperity of farmers in their trade areas. In other words, if the farmer prospers, so also does the businessman. For this reason, businessmen often encourage proposals to increase the number of farms in their trade areas and support measures designed to improve the economic position of farmers.

In South Dakota, where rainfall is considered a limiting factor in agricultural production, considerable interest has been taken in irrigation as a means for increasing farm in-

come. Since one of the largest proposed areas for irrigation in this state is the Oahe Irrigation Unit, it is of interest to find out now to what extent the commercial economy within and near the area would be stimulated with the expected expansion of the agricultural economy.

67% Increase in Dollar Volume Estimated

Recently completed research by the Agricultural Economics department shows that an increase of 67 percent of the total dollar volume of business may be expected, although this figure cannot be taken as final because it is based only on preliminary estimates and data.

In this study, the commercial expansion estimates for the Oahe area are shown in terms of additional volume of business for selected re-

tail, wholesale, service and industrial establishments. These volume estimates are based on several assumptions: first, that 750,000 acres in the area will be irrigated. This figure was an original estimate of irrigable acres in the Oahe Unit by the Bureau of Reclamation. It can be expected, however, that changes in the number of acres to be irrigated will be made after the results of studies dealing with soils, water, climate and topography of the area are available.

Another important assumption was that the income and expenditure pattern after irrigation would be the same as that existing before the development. The pattern of spending of farmers may also change in the future, but again, until more information is available relative to expected future spending patterns, the future buying habits are assumed to be those existing at present.

How Many More Families?

The procedure used in determining commercial expansion from irrigation development was to estimate the rural and urban increases in population in the Oahe area and then total the effect of such population growth on the commercial economy in the area.

An increase in rural population is expected to result as more farm families are needed to operate additional farms established as a result of irrigation. The rural increase in population was determined multiplying the average size farm family in South Dakota in 1950 by the additional farm families expected after development.¹

The number and location of additional farms that might be expected as a result of irrigation were derived from farm development studies. In these studies, farm budgeting factors were used in determining size, location, and type of farming enterprise to be undertaken. Such factors would include classes and location of land and the percentage of land that was considered irrigable.²

The increase in urban population was estimated by multiplying rural to urban population ratios—computed from 1950 population data—by the estimated increase in rural population. To this urban estimate was added population expected to be connected with new types of processing plants. The dry land ratio only reflects what population might be expected if the rural-urban population relationships after irrigation were the same as before. Thus allowances were made for population that may be connected with new industries such as sugar beet plants, alfalfa dehydration plants, or canning factories.

How Much Will They Spend?

After the total population increase was estimated the effect of expenditures by these people was estimated.

From data gathered of the pre-irrigation economy, 72,373 inhabitants were counted living in the Oahe area. A business volume of

¹The average number of persons per farm family in South Dakota (3.8) was determined by dividing rural farm population in 1950 by number of farms in South Dakota in 1950.

²The number of farms in the Oahe Unit after irrigation development was estimated by the Bureau of Reclamation. These estimates are also based on an assumed 750,000 irrigable acres. Therefore, any change in the number of irrigable acres will affect the estimated number of farms in the unit.

\$161,469,342 was calculated for selected firms within these towns. This is an average of \$2,231.07 per person in the trade area. Then if the increase in population as a result of irrigation is 48,535, the total increase in dollar volume of business may be expected to be \$108,284,870. This is an approximate increase of 67 percent.

The total population after irrigation was thus estimated and the percentage increase in population was multiplied by the pre-irrigation business volume to determine the additional volume. The product of this computation is the commercial expansion that may be expected as a result of irrigation in the Oahe Unit under the assumptions used.

Pro-rating this additional business volume to the towns, or firms within the towns, can be accomplished in accordance with the relative changes in trade area population. However, other economic influences such as transportation facilities, new inventions, innovations, and changes in social values should be considered in such an allocation procedure.

Information Useful for Future Planning

Information about the increase in business activity due to irrigation is valuable for several reasons. When a decision is to be made whether an irrigation project should be developed, we should have some information about the benefits of the project and their comparison to the costs. In doing this, both the benefits from increased farm production and from expanding commercial activity should be considered.

Furthermore, in repaying the costs is it reasonable that the farmers repay construction costs while other groups also benefitting carry no part of the costs of construction?

From an economic standpoint it would seem logical that those benefitting from irrigation should stand the cost of development in proportion to the benefits realized from it. If this is the goal the question arises as to what percentage of total costs the farmer should pay? Or in other words, what part of the total benefits from irrigation will the farmers realize? (Project 197. Leader: Ottar Nervik, Agricultural Economics Dept., cooperating with the Bureau of Reclamation.)





S.D. 101 males mated to New Hampshire females



And gold-barred offspring

An Improved White Plymouth

AVAILABILITY OF STOCK

A limited number of hatching eggs and cockerel chicks were released in the spring of 1953 and it is expected that more will be available in 1954. Releases are made to hatcheries who wish to use such stock in their breeding programs, with preference being given to South Dakota hatcheries. A committee from the South Dakota Poultry Improvement Association has set up recommended release procedures. There will be some commercial chicks, sired by South Dakota 101 males, available from hatcheries in 1954 and probably a larger number in 1955.

D. G. JONES and WM. KOHLMAYER

AN IMPROVED strain of chickens is being released to the trade through hatchery channels this year. The new South Dakota 101's have not only all the good qualities of White Plymouth Rocks from which they were selected, but they are also early feathering, produce large, well-shaped eggs, and are a good meat type. In appearance, the adults do not differ greatly from ordinary White Plymouth Rocks, but they do differ in breeding behavior. This has been brought about by selection and purification of the stock for certain characteristics thought economically desirable.

Early Feathering

Unlike many strains of White Plymouth Rocks, S.D. 101 is pure for early feathering. This is the type of feathering almost universally found in White Leghorns but is seen in a more or less variable degree in most heavy breed chickens. Rarely is it found in the pure state in even some of the better known White Plymouth Rock strains available commercially.

Stock that is early feathering has some very definite advantages over late feathering stock. They are better able to withstand chilling in case of a brooder failure than are their late-feathered relatives. Such birds will usually begin roosting at an ear-



from the pen mating



A pen of pullet progeny from the mating

th Rock--South Dakota 101

lier age also, which may reduce the risk of smothering due to crowding in the corners of the broiler house. Late feathering chicks are more susceptible to feather picking and cannibalism which lead to lowered market value and mortality.

Perhaps even more important than any of these reasons for early feathering, is its desirability from the standpoint of market quality. A few years ago when the average age of birds being marketed for meat as broilers or fryers was 14 weeks or more, even the late-feathering birds could develop a reasonably good coat of feathers by that age (barring feather picking). Now with improved feeding and breeding, it is possible to produce a market size bird in nine weeks or a little more. Late feathering chicks are not likely to be well feathered at this age, so the producer must either keep them until they are more completely feathered or be penalized in market price if sold at that time. Since later gains are less efficient, either alternative is expensive.

Improved Egg Size and Uniformity

S.D. 101's lay large, well-shaped eggs having excellent shell thickness and texture. They are dark brown in color with most of them being flecked with white. This gives them a pinkish or purplish cast which is quite pleasing to the eye. Usually, in breeds laying brown eggs, there is considerable variation in shell color, and sometimes in shape and shell texture, but eggs from S.D. 101's are quite uniform. This further increases the pleasing appearance of the eggs. The uniformity exhibited is probably due in part to mild inbreeding that has occurred during the development of the strain.

Inbreeding has not reached high enough levels to impair the reproductive efficiency of the strain, as is shown by the fact that a 79.7 per cent hatch of fertile eggs was obtained during the past breeding season. Fertility was poor due to the poor condition of the males as a result of a respiratory ailment. When artificial insemination was resorted to, fertility level was satisfactory.

One of the chief ways in which S.D. 101's differ from other White Plymouth Rocks is in the color factors which they carry but which can only be expressed when they are mated to colored breeds or varieties of chickens. They have been selected so that they are pure for the gold and barring factors. In addition, they do not carry the extension factor which, when present, may result in black pigment throughout the plumage of crossbred progeny as would be true with black breeds and varieties. Colored breeds or varieties lacking the extension factor as these do, have the black pigment restricted to the feathers of the neck, wings and tail. New Hampshires, Rhode Island Reds and Columbian Plymouth Rocks are good examples of breeds lacking the extension factor.

Since the various hereditary factors affecting feather color and pattern are known in S.D. 101's and since they are present in a pure state, it is possible to predict the appearance of the offspring of a given cross (with colored chickens) before that cross is made. Likewise, one can be sure that all chicks of a given sex will be uniform in color.

This is not possible with most commercial strains of White Plymouth Rocks, since some birds in the strain may carry gold and some, silver; some may be barred and some non-barred; and some may carry the extension factor and others may not. Crossbreeding under these conditions, will result in an assortment of colors of chicks which, while interesting to look at, lack the uniformity desired by the producer and processor alike.

No Green Shanks

Due to the absence of the extension factor for black pigment, S.D. 101's are not troubled with green or "willow" shanks, a common fault in many White Plymouth Rocks. Also, the grey down common in White Plymouth Rock chicks is not observed in the S.D. 101. Presumably this is an expression of the factor for extension of black and thus would not be expected in this strain. While most of the chicks have yellow down, it is not uncommon to find chicks with a decided buff tint, some being almost as dark as light colored New Hampshire chicks. In the adult stock an occasional bird may show a trace of "salmon breast" and crossbeaks are sometimes observed.

How May S.D. 101's Be Used?

Some suggested means of utilizing this stock are as follows:

(1) They may be maintained in a pure state to give a good strain of White Plymouth Rocks pure for early feathering and free of green shanks.

(2) They may be crossed on other strains of White Plymouth Rocks. Some hybrid vigor with resultant improved hatchability, chick livability and growth rate is usually expected as a result of strain crossing. If used as the male parent in this cross, all pullet chicks will be early feathering and if these in turn are mated to S.D. 101 males, all offspring will be early feathering. Because of the excellent egg size of the S.D. 101's, they should be very useful in improving egg size in those strains of White Plymouth Rocks which are deficient in this respect.

(3) S.D. 101 males mated to New

Hampshires or Rhode Island Reds (as shown in the illustration) produce "gold-barred" offspring of the type shown. This plumage color is lightened so that both surface color and under color is lighter than that of the New Hampshire or Rhode Island Red. This results in a lighter pin feather which improves the appearance of the dressed carcass.

Where egg size is small in the Rhode Island Red or New Hampshire, this cross can be expected to improve egg size. For example, S.D. 101's used as breeders during the past season produced eggs averaging 25.4 ounces per dozen during the breeding season. Rhode Island Reds maintained at this station had an average egg weight of 23.3 ounces per dozen. Crossbreds produced by using S.D. 101 males on Rhode Island Red females produced eggs averaging 25.3 ounces per dozen. Egg production from this cross has been excellent.

S.D. 101 males crossed on New Hampshire females have produced crossbred chicks having excellent growth rate and good conformation or meat type. Females of this type are good egg producers.

Where egg production is the primary objective, it is recommended that S.D. 101 males be crossed on a good production strain of Rhode Island Reds. Cockerels from this cross will make satisfactory meat birds but may not grow as rapidly as S.D. 101's by New Hampshires. The latter cross would probably be most advantageously used where production of meat type birds is the primary consideration, although pullets produced from this cross are good egg producers.

The crosses mentioned above can be made in the opposite direction (that is, New Hampshire or Rhode Island Red males x S.D. 101 females) in which case the cockerel chicks will be gold barred and the females will be red.

(4) S.D. 101's might be used in the production of sex-linked crosses, making it possible to identify the sexes at hatching time. These could be produced by mating S.D. 101 males with a silver or Columbian breed or variety such as the Delaware or Columbian Plymouth Rock or Wyandotte. In this case the two sexes of chicks can be separated at hatching as all males will have white or silvery grey down and the females will have buff or red down. In both sexes some individuals may have stripes down the back, but the basic down color will be silver or buff. Females when feathered will be gold barred like the one illustrated. Males will have silver or Columbian plumage (white body plumage with black in the neck, wing and tail feathers). This feather pattern is much in demand for production of meat birds because all body feathers are white. Any pin feathers present on the dressed carcass or underneath the skin are inconspicuous because of their white color.

(5) Where identification of sexes at hatching time is not important or desired, the cross mentioned in (4) could be made in the reverse direction (Silver or Columbian males x S.D. 101 females) in which case all chicks would be white or silvery gray at hatching. These would then have the Columbian feather pattern. (Project 179. Leaders: D. G. Jones and Wm. Kohlmeier, Poultry Dept.)



A calf receiving subcutaneous inoculation of SBE virus for the study of the disease.

By G. S. HARSHFIELD

Sporadic

BOVINE ENCEPHALITIS

A New Virus Disease of Cattle

A NEW VIRUS disease of cattle, first recorded in South Dakota in 1946, has now been diagnosed in 19 herds. Seventeen of these herds were in 12 counties in the eastern part of the state (see map) and two in neighboring counties in Minnesota. Sporadic bovine encephalitis (SBE) has become fairly widespread throughout the nation since it was first reported in Iowa in 1940, occurring in eight other states, California, Idaho, Kansas, Oklahoma, Texas, Missouri, Indiana, Maryland.

Findings at the State College veterinary laboratory suggest that outbreaks occur in herds that are not under suspicion and are not recorded, because the symptoms are so slight as to escape attention. The

young animals are the ones to suffer most from this disease. Calves under one year of age show more pronounced symptoms than older cattle and the death rate among them is also higher.

SBE cannot be considered a strictly seasonal disease. Outbreaks have started during the coldest months as well as during mild weather. Most of the outbreaks, however, were diagnosed in South Dakota from April through July. The length of time the disease persists in a herd also varies greatly. In some cases it has lasted two weeks, in some, six months. In the more prolonged outbreaks, new cases have appeared at intervals of one to three weeks.

In the fight against the disease one important step ahead has been made. Its cause has been determined. Iowa researchers have found it to be a virus and findings at this Station are in agreement with this. Tests have been conducted with a variety of virus agents through the cooperation of Dr. H. A. Wenner, University of Kansas, and Dr. R. W. Menges, Public Health Service, Federal Security Agency. By these tests, the cause of SBE has been identified as a virus belonging to the psittacosis group.

It is still not known how the disease is spread from animal to animal or from herd to herd. In several of the herds in which the disease has been diagnosed, there is a history of having introduced one or more animals from outside sources within a few weeks before the first animal sickened. This suggests that an apparently recovered animal may be a carrier of the virus and a source of

infection for susceptible cattle when close contacts are provided.

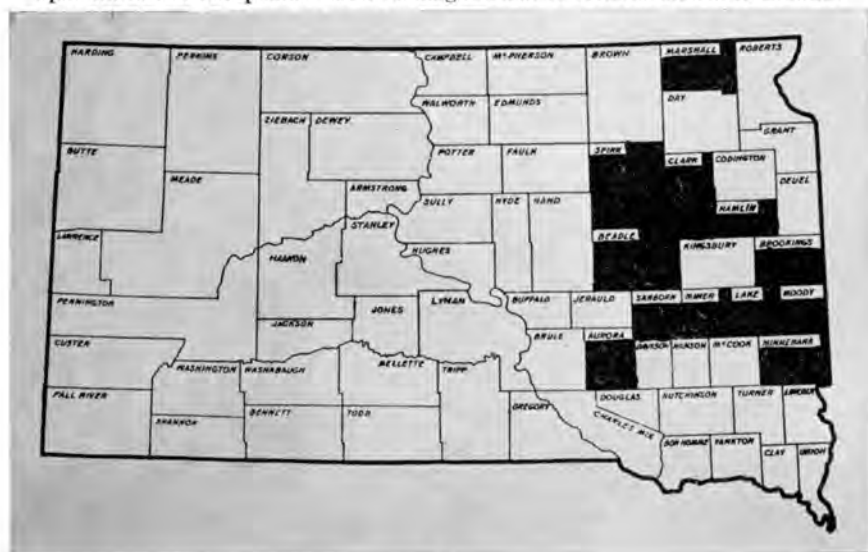
Symptoms

Veterinarians may find SBE difficult to diagnose by symptoms alone. Other diseases which affect the central nervous system produce some of the same symptoms. A definite diagnosis can be made by a post mortem examination.

The first symptom to appear with SBE is an elevation of body temperature of 2 to 4 degrees. There is some depression at this stage, but the owner seldom detects the sick animals until they develop incoordination of the limbs. This may be two or more days after the onset of the disease. This incoordination shows up when the animals walk: they knuckle over in the fetlocks, wobble or stagger. More or less stiffness is apparent, and the appetite is lessened or completely lost.

The severity of symptoms varies

Sporadic bovine encephalitis has been diagnosed in 19 herds located in 12 counties



in affected animals. Some will develop a slight stiffness for a few days and recover. Others—more frequently calves—become paralyzed and lie on the side with the head drawn back until death. A few are down at the first observed indication of sickness, with death occurring in one or two days.

In 13 of the outbreaks, involving 981 animals, 14 percent developed symptoms. Of these, 42 percent (58) died.

Animals Infected Experimentally

At the veterinary laboratory, 17 calves of dairy breeds, three to eight months of age, were infected experimentally by different methods in order to study the disease. The calves were infected by intracerebral, intraperitoneal, subcutaneous and intranasal injection, as well as by feeding chicken-embryo-propagated virus.

The symptoms in all of the experimental cases were mild. When the virus was injected, a moderate fever occurred after five to seven days which persisted for about a week. When given by mouth, fever was not recorded until the fifteenth day. There was more or less depression and a decreased appetite. The only symptom which could be attributed

to involvement of the nervous system was a slight stiffness. None of the experimental calves died as a result of the infection. Those calves which were permitted to recover and were again inoculated with virus were immune.

On post mortem examination of calves killed at varying lengths of time after infection was established, peritonitis, pleuritis and pericarditis were constant and characteristic lesions. Encephalitis and meningitis were also demonstrated by microscopic examination of the nervous system.

Without temperature records and close observation, several of the experimentally produced cases would have escaped detection.

Source of Infection Not Known

Virus of SBE was found in the blood of two of the experimentally infected calves in samples collected during the period of fever. Attempts to demonstrate the virus in nasal secretions, feces and urine have so far failed. To be able to find the virus in the excretions of sick and recovered animals would help to explain the source of infection in herd outbreaks. (Project 171. Leader: G. S. Harshfield, Veterinary Dept.)

NEW PUBLICATIONS

- C101 South Dakota Corn Performance Tests, 1953, by D. E. Kratochvil and D. B. Shank
- B432 TVA Land Acquisition Experience Applied to Dams in the Missouri Basin, by Kris Kristjanson
- B431 Influence of Migration upon South Dakota Population, 1930-1950, by John P. Johansen

*You may obtain copies of these publications from your county agent,
or by addressing a request to the Editorial Office
Agricultural Experiment Station, South Dakota State College, Brookings*

**High Yield Potential, Better
Lodging Resistance and a
More Pleasing Appearance
Are Outstanding
Characteristics of**

New Corn Hybrid SOUTH DAKOTA 250

By D. B. SHANK

A NEW CORN hybrid, South Dakota 250, is being released for the same area of the state as South Dakota 224. This is an area running from east to west on both sides of U. S. Highway 14. S.D. 250 is of the same maturity as S.D. 224, but has a higher yield potential, better lodging resistance and a more pleasing appearance. Single-cross seed of the two parents can now be obtained from the State College Foundation Seed Stocks Division.

Maturity of South Dakota 250

This hybrid has a relative maturity rating of 90 to 95 days. From Table 1 it can be seen that S.D. 250 (formerly Experimental 9 in yield test reports) has consistently contained less moisture than either S.D. 262 or S.D. 270 and is therefore earlier maturing. When compared with S.D. 224, it has possessed the same relative maturity. Over a 4-year period these two hybrids, S.D. 250 and S.D. 224, differed by only 0.4 percent moisture at the time of harvest in the Brookings County tests. As further evidence, they had an average of only 0.8 percent moisture dif-



S.D. 250 has good standability and uniformity

ference for the same four years in Minnehaha County, while in Hanson County they were identical.

A Good Yielding Hybrid

Yield results presented in Table 1 show that S.D. 250 always outyielded S.D. 224 in Brookings, Minnehaha, Hanson, and Brule county test plots. Over 3- and 4-year periods, the new hybrid produced an average of from 5 to 10 bushels more corn per acre than did S.D. 224. Furthermore, it out-produced South Dakota hybrids 262 and 270 in most instances. In Brown and Hyde county trials in 1953, S.D. 250 outyielded both 224 and 262 (Table 2). In Butte county on irrigated land, it had the top yield with 101.6 bushels per acre in a test including 23 commercial hybrids.

Resists Root Lodging

In both 1952 and 1953, some root lodging was caused in the Brookings county test plots by storms

Table 1. Performance Record of South Dakota 250 in Comparison with South Dakota Hybrids 224, 262, and 270 for Several Years at Four Locations

| | 1953 | | | 2-Year Average | | | 3-Year Average | | 4-Year Average | |
|----------------------|--------------|------------------|----------------------|----------------|------------------|----------------------|----------------|------------------|----------------|------------------|
| | Yield Bu./A. | Moisture Percent | Root Lodging Percent | Yield Bu./A. | Moisture Percent | Root Lodging Percent | Yield Bu./A. | Moisture Percent | Yield Bu./A. | Moisture Percent |
| Brookings County | | | | | | | | | | |
| S. D. 250 (Exptl. 9) | 85.3 | 19.8 | 1.3 | 80.7 | 22.1 | 3.8 | 66.6 | 30.9 | 67.2 | 31.5 |
| S. D. 224 | 78.1 | 22.1 | 9.1 | 70.4 | 22.2 | 15.6 | 58.9 | 29.8 | 59.8 | 31.1 |
| S. D. 262 | 86.4 | 24.3 | 18.2 | 78.3 | 24.1 | 21.8 | 63.1 | 33.4 | 63.5 | 34.5 |
| S. D. 270 | 89.3 | 26.2 | 7.8 | 82.7 | 24.9 | 8.1 | 66.2 | 32.5 | 64.9 | 35.3 |
| Minnehaha County | | | | | | | | | | |
| S. D. 250 (Exptl. 9) | 61.5 | 20.2 | — | 64.3 | 18.6 | — | 56.1 | 24.6 | 51.2 | 22.8 |
| S. D. 224 | 58.5 | 18.2 | — | 57.8 | 16.6 | — | 49.4 | 24.3 | 48.6 | 22.3 |
| S. D. 262 | 64.7 | 21.0 | — | 61.8 | 19.4 | — | 52.0 | 27.7 | 48.8 | 25.0 |
| S. D. 270 | 64.0 | 20.8 | — | 67.8 | 17.8 | — | 56.3 | 26.7 | 52.0 | 24.6 |
| Hanson County | | | | | | | | | | |
| S. D. 250 (Exptl. 9) | 66.0 | 10.3 | — | 62.2 | 10.5 | — | 55.6 | 18.0 | 57.7 | 19.3 |
| S. D. 224 | 54.8 | 10.1 | — | 55.3 | 10.0 | — | 49.7 | 17.8 | 50.5 | 19.3 |
| S. D. 262 | 64.7 | 11.4 | — | 60.1 | 11.4 | — | 51.6 | 20.5 | — | — |
| S. D. 270 | 61.7 | 10.9 | — | 59.8 | 11.5 | — | 53.5 | 19.3 | 55.5 | 20.5 |
| Brule County | | | | | | | | | | |
| S. D. 250 (Exptl. 9) | 43.3 | 10.9 | — | 42.9 | 9.2 | — | 36.6 | 22.2 | — | — |
| S. D. 224 | 41.4 | 11.1 | — | 34.8 | 9.1 | — | 30.7 | 23.5 | — | — |
| S. D. 262 | 48.1 | 10.9 | — | 41.5 | 9.1 | — | 35.7 | 25.4 | — | — |
| S. D. 270 | 33.3 | 10.9 | — | 38.1 | 9.2 | — | 33.5 | 24.2 | — | — |

Table 2. Results from Performance Tests in Brown, Butte, and Hyde Counties in 1953

| | Brown County | | Butte County* | | Hyde County | |
|----------------------|--------------|------------------|---------------|------------------|--------------|------------------|
| | Yield Bu./A. | Moisture Percent | Yield Bu./A. | Moisture Percent | Yield Bu./A. | Moisture Percent |
| S. D. 250 (Exptl. 9) | 67.6 | 14.0 | 101.6 | 13.8 | 65.1 | 11.7 |
| S. D. 224 | 64.6 | 13.3 | 91.7 | 13.5 | 63.1 | 11.6 |
| S. D. 262 | 65.1 | 14.3 | 77.1 | 13.8 | 63.3 | 13.4 |
| S. D. 270 | 71.5 | 16.9 | 89.8 | 13.5 | 68.9 | 13.1 |

*The test in Butte County was conducted by Joseph L. Bohnemann and Bruce L. Baird, Division of Soil Management and Irrigation Agriculture, BPI&A, USDA, Newell Irrigation and Dry Land Field Station.

which came just before the corn plants developed ears. In each case, notes were taken on the percentage of plants which had root lodged 30 degrees or more. Differences among four South Dakota hybrids are given in Table 1. S.D. 250 had 3.8 percent weak-rooted plants as a 2-year average, which was less than half as much lodging as that of its closest competitor, S.D. 270. On the other hand, South Dakota hybrids 224 and 262 had 15.6 and 21.8 percent root lodging, respectively.

There is nothing unusual about the plants of S.D. 250 by which it can be readily identified. However, it has a very pleasing appearance in the field because it does not lodge easily, the stalks are quite uniform, the leaves are broad and shatter resistant, and it has good sized ears which show up well late in the season. The ears are smooth, with deep, well dented kernels that have a rather wide space between the rows because of a rounding of the crowns.

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Oyster-Shell SCALE

It may kill a tree or a bush, or it may stunt and weaken the infested plant so that it is susceptible to other plant enemies. It can be controlled by spraying with DDT or with a lime sulfur dormant spray.

By H. C. SEVERIN



Fig. 1. Apple twigs infested with oyster-shell scales. Left, twig heavily encrusted; right, twig not so badly infested.

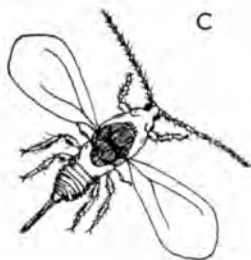


THE TINY brown oyster-shell scale is not choosy which tree or bush it selects for its shelter and food supply. It will attack most of the trees grown in South Dakota (except evergreens) and has a special liking for some of our most cherished trees.

The insects are found most frequently on apples, plums, currants, gooseberries, flowering plum, poplars, willows, ash, mountain ash, cotoneaster, and lilacs. Fruit and shade trees, or bushes that are crowded and shaded and not sprayed or pruned, suffer more from the attacks of the oyster-shell scale than do those that are properly cared for.

The scale insects usually live on the bark, but sometimes they also attack the fruit of trees such as apple. At times they become so numerous that they encrust the twigs, branches and trunks of a tree and cover the bark entirely (Fig. 1). They do their damage by inserting a long, flexible set of tube-like mouth parts (F) into the plant tissue and sucking out the sap of the plant. The loss of sap may stunt or even kill the tree, and its weakened condition may make the plant subject to the attack of other enemies.

It is the female oyster-shell scale that is chiefly responsible for the damage done by this pest, and for once



the fair sex deserves all the blame it gets. The females are not only bigger than the males, but they also are much more abundant. The males exist in comparatively small numbers and, after they have been transformed from the tiny scales to delicate, two-winged insects (C) they mate and die.

Their Life Story

The female oyster-shell scale, which is about one-eighth of an inch long, looks like a very small oyster shell, except that when the shells are crowded they become much distorted. They die in the course of one year, but not before they have laid from 30 to 125 eggs. The egg laying is done in the fall, and the white eggs, along with the much shrunken body of the mother insect, can be found in late fall, winter or early spring by turning over a scale with a pin or needle (B).

The eggs remain unhatched until the following June or latter part of May when they give rise to minute, dust-like, whitish young (E). The young insects make their way out from underneath the mother scale, crawl over the bark for a few hours and then push their thread-like mouth-parts into the plant tissue to feed.

If the insect is a female, it remains where it first settled. Here it grows and soon begins to secrete a shell-like covering which later becomes brown and scale-like and serves as a protection to the delicate insect beneath. During its life, the female insect grows and increases the size of its scale-like covering. It molts or sheds its skin twice during this time and adds the cast skins to one end of

the scale (A). In contrast to the female, the male scales are much smaller and they attach but one skin to their scale (D).

The young scale insects, when they hatch from the eggs, are capable of moving about. They may crawl on the bodies of other insects, birds or other animals and thus be carried considerable distances from where they hatched from the eggs. If these animals should happen to come to rest on another uninfested host plant or rub against it and if the scale insects leave the animal and crawl to the plant, then that plant stands an excellent chance of becoming infested. Winds also carry the young scales, just as winds may carry dust particles, and are frequently responsible for the rapid spread of oyster-shell scales from infested to uninfested plants.

Control Recommendations

When nursery stock is to be set out, the trees or shrubs should be carefully examined for the presence of oyster-shell scale. If the stock is found to be infested, it should not be planted.

All worthless trees or bushes that are infested with oyster-shell scale should be cut down at the level of the ground or slightly below and burned. More valuable trees or bushes should be severely pruned, and this should be followed by a campaign of spraying until the scale has been eliminated. Trees and bushes that are kept in a thrifty condition and are not crowded, seldom suffer serious damage from this scale insect.

Oyster-shell scale may be destroyed by spraying (1) when the

trees or bushes are in a dormant state or (2) in the spring when they are not. Several insecticides can be used in sprays to control the oyster-shell scale, but only two will be discussed, namely, a lime sulfur spray solution and a DDT spray.

Lime Sulfur Spray Used When Trees Are Dormant

When using the lime sulfur spray, the label on the container should be read carefully and the dilution with water made according to the manufacturer's recommendation. The dormant lime sulfur spray should be applied any time when the trees or bushes are dormant and before the buds have begun to open in the spring. The lime sulfur loosens the scales from the bark, and as a consequence many of the eggs that were underneath the scales are blown away or they are destroyed by being exposed to the elements and to natural enemies.

DDT Applied in Spring after Eggs Hatch

The DDT spray should be applied to the trees or bushes in the

spring after the eggs have hatched and before the young scale insects have secreted a heavy scale over their bodies. An excellent DDT spray may be made up by adding 2 pounds of 50 percent wettable powder of DDT to 100 gallons of water.

Ordinarily the eggs of the oyster-shell scale hatch one to three weeks after the apple blossoms have dropped from apple trees. If a spray of DDT as recommended is applied to the infested trees and bushes immediately after the petals of apple trees have fallen, and if a second application is made 10 days later, most of the young scale insects should be destroyed.

A thorough job of spraying must be done if satisfactory results are to be obtained. All parts of the trees or bushes must be covered with the spray, including the trunk, larger limbs and the smallest twigs. (Project 220. Leader: H. C. Severin, Entomology Dept.)

Insects pictured on page 43 are: A, female scale viewed from above; B, female scale seen from beneath; C, Adult male scale insect; D, adult male scale seen from above; E, young scale insect recently hatched; F, adult female scale insect showing sucking mouth parts. All enlarged.

A New Corn Hybrid

Continued from page 42

Occasionally the ears have rather irregular rows.

South Dakota 250 Made Possible by Interstate Cooperation

The pedigree of S.D. 250 is (Oh-56A x B8) (M14 x SD5). Of these lines, only SD5 was developed in South Dakota. Oh56A is an Ohio inbred, M14 comes originally from Illinois, and B8 is from Iowa. When made as given above, S.D. 250 is es-

entially a matched hybrid. At the most, the single crosses would not need to be planted more than one week apart. Of the two single crosses, (Oh56A x B8) is just a little later than (M14 x SD5).

A policy for the free exchange of inbred lines exists among the corn breeders working at state experiment stations. Such exchange of material has made the development of S.D. 250 possible. (Project 66. Leaders: D. B. Shank, and D. E. Kratochvil, Agronomy Dept.)



HULLESS OATS

FOR FATTENING *Lambs*

By R. M. JORDAN

THE DEVELOPMENT of James hull-less oats by the Agricultural Experiment Station at South Dakota State College has renewed interest in the feeding value of hull-less oats for all classes of livestock. It has long been popular as a feed for baby pigs because of its high protein and energy content and low fiber. Less is known about its relative feeding value for ruminants in comparison to shelled corn.

Since it is a less hazardous crop to grow than corn in certain areas of the state, and since average yields of hull-less oats range from 25 to 50 bushels an acre, it may offer an alternative for corn as a feed for livestock. To determine the feeding value of hull-less oats for ruminants, in comparison to shelled corn, three lamb feeding trials were conducted at the Station during 1952-53.

Hull-less Oats Compared to Shelled Corn

In the first two trials, conducted during the fall and winter, western feeder lambs of good quality were used as test animals. In the third trial, conducted during the summer months, native spring lambs were used as test animals. In all three

trials the lambs were housed in a shed with small outside exercise lots available. Fresh water, minerals, and salt were provided the lambs at all times. The experimental rations fed were as follows:

Trial One: Lot I—a full feed of shelled corn, 1.84 pounds of alfalfa-brome hay and 0.2 pound of soybean meal per lamb daily. Lot II—a full feed of hull-less oats, 1.84 pounds alfalfa-brome hay and 0.2 pound of soybean meal per lamb daily.

Trial Two: The rations were the same as in Trial I, except that only 0.1 pound of soybean meal and 1.45 pounds of alfalfa-brome hay were fed per lamb daily.

Trial Three: Grain and protein supplement were fed as in Trial I. In addition, each lamb consumed 1.5 pounds of alfalfa-brome hay per day.

Table 1. Chemical Analysis of No. 2 Yellow Corn and Hull-less Oats

| | Yellow Corn | Hull-less Oats |
|-----------------------|----------------|-------------------|
| | % | % |
| Moisture | 15.00 | 10.79 |
| Ether extract | 3.90 | 5.02 |
| Crude fiber | 2.00 | 2.37 |
| Crude protein | 8.60 | 15.94 |
| Ash | 1.90 | 2.56 |
| Nitrogen-free extract | 69.30 | 63.32 |

Analyses of the hullless oats and corn are shown in Table 1. On the basis of chemical analysis alone, hullless oats appears to be comparable to shelled corn.

WHAT WE FOUND OUT

1. Lambs fed hullless oats did not find it as palatable as shelled yellow corn, since in two out of three trials they ate less feed than the lambs receiving shelled corn. However, in the one trial in which the consumption of hullless oats was as great as that of corn, excellent results were obtained.

2. In two out of three trials, the rate of gain of the lambs receiving hullless oats was less than that of the lambs receiving shelled corn.

3. In all three trials conducted, slightly more feed was required per 100 pounds of gain for the lambs receiving shelled corn.

4. The ration fed did not affect carcass yield or grade.

The results of the three trials and a summary are presented in Table 2.

The most outstanding difference that existed in the first trial was the difference in grain consumption between the two lots. Both lots were fed 0.25 pound of grain per head daily at the beginning of the trial and increased to about 1.6 pound. It took longer to get the lambs receiving hullless oats on full feed and it was more difficult to keep them on feed. Consequently, their average daily feed consumption was about 0.1 pound less than for the lambs in the lot receiving corn (corn 1.38 pounds, hullless oats 1.26 pounds per lamb daily).

Lambs on Hullless Oats Tire of Feed More Easily

In the second trial, average daily feed consumption was the same in both lots (1.55 pound). However, in the third trial it was evident that the

Table 2. Comparison of Shelled Corn and Hullless Oats for Fattening Lambs

| | Fall and Winter | | | | | | | |
|------------------------|-----------------|----------------------------|---------------|----------------------------|---------------|----------------------------|----------------|----------------|
| | 1952 | | 1953 | | Summer 1953 | | 3-Year Summary | |
| | Corn Lot I | Hullless Oats Lot II | Corn Lot I | Hullless Oats Lot II | Corn Lot I | Hullless Oats Lot II | Corn Lot I | Oats Lot II |
| Number of lambs | 25 | 25 | 25 | 25 | 18 | 19 | 68 | 69 |
| Days fed | 81 | 81 | 86 | 86 | 57 | 57 | 75 | 75 |
| Av. initial wt., lbs. | 71.9 | 70.3 | 67.7 | 66.1 | 80.8 | 73.1 | 73.4 | 69.8 |
| Av. final wt., lbs. | 100.6 | 96.9 | 103.4 | 107.2 | 104.6 | 92.8 | 102.8 | 98.9 |
| Gain per lamb, lbs. | 28.7 | 26.6 | 35.7 | 41.1 | 23.8 | 19.7 | 29.4 | 29.1 |
| Av. daily gain, lbs. | 0.35 | 0.33 | 0.42 | 0.48 | 0.42 | 0.35 | 0.40 | 0.38 |
| Feed per 100 lbs. gain | | | | | | | | |
| Grain | 385.3 | 378.6 | 373.5 | 324.3 | 363.6 | 338.1 | 374.7 | 356.7 |
| Hay | 520.3 | 559.4 | 349.4 | 303.3 | 359.0 | 434.0 | 400.0 | 411.0 |
| Protein | 55.9 | 60.2 | 24.1 | 20.9 | 43.1 | 52.0 | 40.5 | 41.7 |
| Selling price | \$19.00 | \$19.00 | \$23.60 | \$24.00 | | | | |
| Carcass yield, % | 49.1 | 48.6 | 51.7 | 51.2 | | | | |
| Feed cost* | \$17.62 | \$18.06 | \$14.04 | \$12.19 | \$14.84 | \$15.39 | | |

*Feed prices used: Corn, 2½ cents per pound; hullless oats, 2½ cents per pound; hay, \$20 per ton, and soybean meal \$100 per ton.



Lambs fed hulless oats did not find it as palatable as shelled yellow corn, but when the lambs consumed as much oats as they did corn, excellent results were obtained.

lambs receiving hulless oats did not find it as palatable as shelled corn and did not eat as much as those receiving corn (average daily grain consumption: corn 1.52 pounds, hulless oats 1.17 pounds per lamb daily). Hay and protein supplement consumption was the same in both lots during all three trials.

Less Feed Required for 100 Pounds Gain on Hulless Oats

The average daily rate of gain of the corn-fed lambs in the first trial was 0.35 pound as compared to 0.33 pound made by the lambs fed hulless oats. In the second trial the corn-fed lambs gained 0.42 pound, and the lambs on hulless oats, 0.48 pound per lamb daily. In the third trial the control lambs gained 0.42 pound per lamb daily as compared

to 0.35 pound gained by the hulless-oats fed lambs. The lower rate of gain in the first and third trials is likely due to the smaller intake of feed. The feed required for 100 pounds of gain was less for the lambs receiving hulless oats in all three of the trials. The rations fed apparently had no bearing on the carcass grade or yield.

On the average, the lambs receiving shelled corn gained slightly faster, consumed more feed per day, but required slightly more grain per 100 pounds of gain. Mixing hulless oats and corn together has increased feed intake and may be the preferred method of feeding it to ruminants so as to assure a high level of grain consumption. (Project 199. Leader: R. M. Jordan, Animal Husbandry Dept.)

Precautions WHEN USING *Chemicals* FOR *Weed* CONTROL

By LYLE A. DERSCHIED

CHEMICALS are highly efficient tools in weed control. Like other tools or machinery the farmer uses, they are helpful when used correctly, but are dangerous if used carelessly.

In the past, farmers have learned how to operate many types of machines. Now farmers must learn how to use the new chemicals to control weeds with a minimum of injury to their crops or to those of their neighbors. As with machinery, it is important to know the potentialities of these tools and to exercise extreme care in their use, if satisfactory results are to be obtained.

Hazards Encountered

Actual experiences emphasize that hazards exist in using chemicals for weed control and that precautions are necessary when using them. In one instance, a farmer wished to spray a grain field that was located along the south side of a shelterbelt. He used a boom-type sprayer and waited until the wind was in the north. These precautions kept any drift from getting into the shelterbelt. However, he used a standard ester of 2,4-D which gave off some fumes. That night the wind blew from the south, carrying the fumes into the shelterbelt. Some of the trees lost their leaves. If this farmer had used an amine form or a low volatile ester form of 2,4-D, there would not have been enough vapors to cause any damage to the

Clothing and shoes, when soaked with spray, may cause irritation to skin.



trees. Low volatile esters cost more money than the standard esters, but are sometimes worth the extra money in situations like this.

Another farmer finished spraying and backed his sprayer into the grove out of the way. Although he had been using an amine form of 2,4-D and had flushed the sprayer thoroughly, he was not able to remove all of the vapors. These fumes killed the leaves on the trees immediately above the sprayer. If one wishes to store his sprayer near plants that are sensitive to 2,4-D, it is advisable to wait two or three weeks after he has finished spraying. Most of the fumes will be gone by then.

In a third instance, a city dweller sprayed his lawn to kill the dandelions. He was careful not to get any drift on his wife's flowers and garden, but after he finished spraying he threw the empty 2,4-D container out by the garbage can. Enough fumes came out of the empty container to ruin the tomatoes in a nearby garden. He had used a volatile form of 2,4-D and the fumes might have injured the flowers and shrubs near the lawn even though drift did not get on them. It is advisable to use a low volatile ester when spraying a lawn surrounded by such sensitive plants.

Drifts and Vapors Dangerous but Controllable

Sprays of 2,4-D, MCP or 2,4,5-T are easily drifted considerable distances by air movement. Drifting is more serious if the sprays are applied by turbine, airplane or boomless ground sprayer than when applied with a boom-type ground

sprayer. Dusts drift farther than sprays. The drift may damage gardens, flower beds, trees or other sensitive plants nearby.

One must not only guard against drift at the time of spraying, but must guard against vapors after spraying, if sensitive plants are growing near the sprayed area. The standard ester forms of 2,4-D or 2,4,5-T volatilize after the spraying is done, giving off vapors or fumes that may be carried considerable distances in concentrations that are toxic to sensitive plants. Amine forms also produce some vapors, but as a rule are less volatile than the esters. The danger of these vapors exists for several hours or days after the spraying operation is completed. Low volatile esters of 2,4-D and 2,4,5-T do not give off many vapors after spraying, but will drift like the other forms at the time of spraying.

Crop Abnormalities Do Not Necessarily Mean Yield Reductions

After the application of 2,4-D or MCP in crops tolerant to these chemicals, some abnormalities may appear. Many of these abnormalities make it appear that the crop is ruined, when in reality the final yield is not hurt. In fact, the yield is often increased because the competition from weeds is removed.

Flax, for example, often lies flat after being sprayed with 2,4-D. One farmer was ready to plow up such a flax field and plant another crop. After he learned that flax often reacted like that, but usually recovered in a week or 10 days, he decided to let it go. It produced almost 20 bushels to the acre. Flax has a better chance

of recovering if sprayed when only 3 or 4 inches tall.

Corn often acts like flax in that many plants bend over and become brittle shortly after spraying. Young plants affected in this manner are seldom injured permanently. They usually recover and produce a full yield. However, plants that are 2 or 3 feet tall sometimes are broken by the wind. Heavy applications of 2,4-D (over one-half pound of 2,4-D acid per acre) often produce abnormal brace roots. Again the yield is seldom decreased unless the roots are injured to the extent that they will not hold the plant upright.

Abnormal heads sometimes appear in small grain, but the yield is seldom decreased if the grain was sprayed before it reached the boot stage of growth. However, abnormalities resulting from spraying when the grain is in the boot or is heading are often accompanied by a reduction in yield.

TCA Caustic and Corrosive

Relatively high amounts of TCA are needed to kill plants; therefore, drift and volatilization are not much of a problem. However, this chemical is irritating to the skin. In fact, doctors used to prescribe it for removing warts. Small droplets of TCA spray that splash on the face will leave a burning sensation and cause the skin to itch for some time. These irritations are not serious, but are uncomfortable. They can be removed by washing the infected spots with soap and water. Such problems are encountered more often with a TCA powder than with a liquid form.

TCA is also corrosive to alumi-

num, copper and brass fittings on a sprayer, but does not seem to have much effect on iron. This means that a sprayer equipped with aluminum tanks should not be used to apply TCA sprays, and that copper and brass fittings should be washed thoroughly after using TCA. The Station uses a machine equipped with copper pipes and brass valves and nozzles. After spraying with TCA, the copper pipes are tightened at the joints and the entire sprayer is flushed with water. All parts are still as good as new and TCA has been used in the sprayer every year for five years.

Liquid forms of TCA will eat through the tin cans in which they are sold, which makes it inadvisable to plan on storing this material for more than 90 days.

Chlorate Inflammable and Corrosive

Sodium chlorate is inflammable, but has been used by many people for many years without causing any appreciable damage. Clothing or foliage that has been wet with a spray of sodium chlorate is easy to set on fire when it dries. Sometimes a stamp of the foot is enough to ignite it. However, the fire hazard can be almost eliminated with a few simple precautions such as (1) cutting the weeds before spraying them, (2) wearing rubber boots when walking through the sprayed area, (3) being careful not to get the clothing wet and (4) being careful not to smoke in the sprayed area. Also by applying the chemical dry instead of as a spray, the danger of fire is reduced considerably. How-

Continued on page 74

Fly Control ON THE FARM

By WM. M. ROGOFF

(Top) Horn flies on cattle are generally susceptible to insecticides. Power sprayers at high or low pressures are very effective. (Bottom) Power spraying of walls of dairy building with insecticides will help eliminate house flies and stable flies on the farm.



THREE SPECIES of flies are common on South Dakota farms, and to control them effectively different methods and insecticides have to be used. If the farm operator is able to distinguish the three most common pest flies at a glance and is familiar with their characteristics and habits, he will be much better able to deal with them. The choice of insecticides varies for the different species, and even where one insecticide, like lindane or DDT, has wide applicability, the concentration to be used will be different in some situations than in others. Also, the method of application of insecticides or other control procedures will differ with the problem at hand.

Recognizing the Species Important

The house fly is objectionable primarily because of its unsanitary habits. It breeds in almost any kind of decaying organic matter and is found in such places as homes, barns, milk houses, barnyards or privies. This fly cannot pierce the skin to suck blood and therefore is not greatly bothersome to cattle.

The stable fly is a blood sucker. On cattle, it feeds chiefly on the legs, but also on the sides and backs. It is commonly seen in barns and barnyards, resting on walls, ceilings, or fences, as well as on the animals themselves. These insects, however, do not rest on the animals for any length of time after blood has been taken. The stable fly breeds in wet straw, close to farm buildings or around feed bunks. It is not an important pest of range cattle. The stable fly is the same size and general shape as the house fly,

though it can be distinguished from the latter by the pointed, forward projecting proboscis (mouth parts) on its head. This proboscis, which the stable fly uses for sucking blood, can be readily seen when the fly is at rest in a well-lighted location, as on the sunny, outside wall of a barn, or when resting indoors on a window.

The horn fly is also a blood sucker, but it is considerably smaller than the stable fly and is generally seen on the backs and withers of cattle. It spends most of its time on cattle, in contrast to the stable fly which visits animals only when feeding. The horn fly breeds in fresh cattle droppings and is a serious pest on the range as well as in pastures.

Control of Flies on Stock

The control of flies on stock may be fairly easy if the infestation is limited to horn flies. If it includes any large number of stable flies, discouraging results are not unusual.

Horn Flies. Horn flies, partly because of their habit of resting on cattle whether they are drawing blood or not, and partly because of general susceptibility to insecti-

cides, are easy to manage. No proven cases of insecticide resistance in horn flies have yet been reported. Any one of the common insecticides, such as DDT, toxaphene, TDE, methoxychlor, the synergized (activated) pyrethrums or the thio-cyanates should prove effective. The last three are the only materials recommended for use on dairy cattle or on beef cattle being finished for slaughter. Recommended concentrations are shown in Table 1.

The method of application will vary with the local situation. Power sprayers, at low or high pressures, are very effective. Cable-type backrubbers (described in Bulletin 418), are effective, inexpensive, and easier to use than sprayers. When backrubbers are properly located and when serviced every few weeks, horn fly control is easily accomplished. Excellent control of these flies was obtained by this method even on a herd of dairy calves confined to a shelterbelt during the summer of 1953. Thus, the fact that there are trees or other places to rub does not necessarily mean that cattle will not use these devices. Some custom-built backrubbers or oilers have a place, but

Table 1. Sprays on Stock for Fly Control

| Stock | Insecticide | Method of Mixing 100 Gals. of Spray | Concentration of Finished Spray Percent |
|--|------------------------------|-------------------------------------|---|
| Dairy cattle and beef being finished for slaughter | methoxychlor | 50% W.P., 8 lbs.; 25% E.C., 2 gals. | 0.5 |
| | synergized pyrethrum | as directed on label | — |
| Beef cattle | thiocyanates | as directed on label | — |
| | Same as for dairy cattle or: | | |
| | DDT | 50% W.P., 8 lbs.; 25% E.C., 2 gals. | 0.5 |
| | TDE | 50% W.P., 8 lbs.; 25% E.C., 2 gals. | 0.5 |
| | toxaphene | 50% W.P., 8 lbs.; 45% E.C., 1 gal. | 0.5 |
| | chlordane | 50% W.P., 8 lbs.; 45% E.C., 1 gal. | 0.5 |

*One pound of a wettable powder per 100 gallons of water is equal to $\frac{1}{2}$ ounce per three gallons of water.

One gallon of an emulsifiable concentrate per 100 gallons of water is equal to $2\frac{1}{2}$ tablespoons per gallon of water.

W.P. = wettable powder

E.C. = emulsifiable concentrate

Table 2. Treatments for Premises for Fly Control

| Location | Insecticide | Method of Mixing 100 Gals. of Spray Using Available Formulations | Concentration of Finished Spray Percent |
|-------------------------------------|------------------------|---|---|
| Dairy buildings | methoxychlor | 50% W.P., 40 lbs.; 25% E.C., 10 gals. | 2.5 |
| | lindane | 25% W.P., 10 lbs.; 20% E.C., 5 qts. | 0.3 |
| | malathion | 50% E.C., 2 gals. | 1.0 |
| | chlordane | 50% W.P., 32 lbs.; 45% E.C., 4 gals. | 2.0 |
| Buildings other than dairy | Same as for dairy, or: | | |
| | DDT | 50% W.P., 40 lbs.; 25% E.C., 10 gals. | 2.5 |
| | toxaphene | 50% W.P., 32 lbs.; 45% E.C., 4 gals. | 2.0 |
| | chlordane | 50% W.P., 32 lbs.; 45% E.C., 4 gals. | 2.0 |
| | TDE | 50% W.P., 40 lbs.; 25% E.C., 10 gals. | 2.5 |
| | Diazinon | 25% W.P., 32 lbs. | 1.0 |

only when so constructed that over-treatment is impossible. In general, they tend to be expensive, though some of them require little maintenance. In any event, whether farm-built or custom-built backrubbers are used, lubricating oils, new or waste, should not be used. Fuel or Diesel oils are widely used as solvents for DDT or methoxychlor (either of which should be used at 5 percent strength).

Stable Flies. If the infestation of flies on stock includes significant numbers of stable flies, the problem is much more complicated than for horn flies alone. Stable flies feed for a relatively short time and then leave the animals. This characteristic, plus their natural resistance to chemicals, makes stable fly control difficult in some situations, and virtually impossible in others. The synergized (activated) pyrethrums and the thiocyanates, with or without the addition of repellents, seem to provide the best control. Unfortunately these chemicals are of comparatively short residual duration and their use involves frequent re-treatment. Such re-treatment is usually impractical in beef herds except where automatic spraying

equipment, such as the treadle-type sprayer, is available. These sprayers are operated by the cow as it steps on a platform in a chute through which the animal must pass.

Experiments during the last three years with cable-type backrubbers have shown that these devices are as effective as sprayers in applying residual insecticides such as DDT. While some relief was afforded, neither of these procedures could be regarded as satisfactory in the face of moderate to heavy infestations. Repellents applied by means of the cable-type backrubber were ineffective.

Removal of breeding areas, in this case the removal of spilled feed and old straw bottoms, may provide considerable reduction of stable flies under some circumstances. In many cases, however, the elimination of breeding areas may be an entirely impractical venture.

House Flies. The importance of house flies on stock is relatively small since these flies do not suck blood. To keep them off cattle for purposes of over-all sanitation in milk handling establishments, they are best handled by treatment of premises rather than stock

Control in and Around Buildings

Fly infestations requiring control in and around buildings consist primarily of house flies, stable flies, or both. The first essential to successful control of these infestations is sanitation: the elimination of breeding areas and the reduction in quantity of materials attractive to flies.

The use of insecticides has been complicated by the widespread development of resistance to chlorinated organic insecticides on the part of house flies. Where such resistance is established, certain organic phosphate insecticides may be used. Several of these latter materials have shown great promise but may not be available for general use in 1954. Insecticides available for use in and around farm buildings are summarized in Table 2. Some of these materials may be applied as standard residual sprays, others are best applied as spot treatments on door and window edges where flies tend to rest.

The use of bait in association with insecticides has been highly successful in certain situations but not in others. TEPP bait (with or without lindane) applied to clean floors or on burlap sacking appears to be useful when proportionately large areas can be treated and when breeding rates can be overcome by such treatment. Such baits are usually mixed with water and applied

with a sprinkling can. However, TEPP is one of our most dangerous insecticides and must be handled with extreme caution. There is likely to be considerable research interest during 1954 in hardened baits, such as Bayer L 13/59 or other insecticides in Karo syrup, applied with a paint brush as a spot treatment and permitted to dry in place.

Fly Control Methods Must Be Adapted to Particular Problem

The procedures available for control of flies on the farm must be adapted to the particular problem at hand. Control of flies on stock is easy if the infestation is one of horn flies, difficult if stable flies occur in significant numbers. Controlling flies in and around buildings generally requires a combination of many types of treatment, including sanitation in every instance and residual sprays or bait application, or both, depending on the size of the infestation and degree of resistance present. Fly control practices should be established before infestations become too large and should be continued as a routine management practice throughout the fly breeding season. Further information on fly control procedures can be obtained by consulting the county agent, or the Entomology department. (Project 186. Leader: Wm. M. Rogoff, Entomology.)



ANALYZING FEEDS FOR POISONS

O. E. OLSON, G. S. HARSHFIELD and WM. KOHLMAYER

OFTENTIMES, when poultry or livestock become suddenly sick or die, no reason is immediately apparent and an analysis for poison seems to be the most probable means of finding the cause. Actually, where unexplained farm animal losses occur, the possibility of poisoning does exist. However, before requesting an analysis, it would be well to consider the following pertinent information.

Don't Overlook Disease

A number of feeds and other materials are examined every year in this laboratory for poisons, following the unexplained loss of animals. In considerably less than 1 percent of the cases is any poison found. A review of work done at other laboratories reveals that this is a common occurrence. In our experience, the following reasons have contributed most to our finding poison in so low a percentage of the materials we have been requested to analyze:

1. In growing swine, or more often young poultry, changes in feeds are sometimes made. These changes in many cases coincide with sickness or deaths from disease. Unless the disease is easily recognized, the change in feed appears to be the cause and it is perhaps natural to suspect the feed of lacking some essential component or of containing some poison. In almost 100 percent of these cases, some factor other than the feed is responsible, generally a disease.

2. Quite often livestock losses occur along a stream below a sewage disposal plant, during a period when some unusual activities (road building, electric line work, railroad work, etc.) are taking place on or near the pasture, or possibly at a time when neighbors are not very friendly. These circumstances are given excessive concern, and, whereas disease should be

receiving first attention, its consideration may be entirely overlooked.

3. Some diseases are difficult to diagnose without unusual laboratory facilities. The veterinarian, therefore, may fail to recognize them. In many cases he is called after animals have died and he has no opportunity to observe symptoms. He must then rely upon what information the farmer can give him and upon his findings on autopsy (generally performed under far from ideal conditions), and he may find no cause for the deaths. In these cases he may feel that an analysis for some poison should be made, although recognizing the improbability that it will be found present.

4. In a few cases, animals die from poison and yet the chemist can neither determine what poison caused the deaths or whether one was actually present. This will be discussed further in a later section.

In view of the low incidence of cases of poisoning in farm animals as compared to the incidence of disease, it is inadvisable to send samples for analysis before obtaining the services of a competent veterinarian and making every effort to establish that an infectious disease was not the cause of a loss. It would be a good practice, even when the



Station biochemist analyzing for mercury to see if treated seed had been fed to livestock.

SUGGESTED PROCEDURE

In any situation where it is suspected that livestock or poultry are sick or have died as a result of poisons, the following steps should be taken:

1. Call a qualified veterinarian
2. Make a complete survey of the area for possible sources of poison
3. Set aside a sample of the feed or material suspected of containing poison
4. If the veterinarian decides there is a good possibility of poison having caused the losses, obtain from him a written description of symptoms (including post-mortem findings) and his opinion as to the type of poison he suspects
5. Conduct feeding trials, if possible
6. Write out a complete history of conditions surrounding the loss or

sickness of livestock or poultry and send it, the description of symptoms and samples (as advised by the veterinarian) to Veterinary Department, South Dakota State College, College Station

7. Pending the receipt of a reply, assume the cause to be an unidentified infectious disease but remove materials suspected of being poisonous from access to the animals

8. Remember that diagnosis from a distance is a most difficult task. Success in diagnosing will depend largely upon how much helpful information you can give.

situation clearly indicates that a poison may be the causative agent to assume that an infectious disease is responsible until an analysis proves differently, and to act accordingly.

Analyses Are Costly

Contrary to popular opinion, chemical analyses are difficult, tedious and costly. Furthermore, they are limited in their application and give only a part of the answer in establishing whether a poison was or was not responsible in livestock or poultry losses. Finally, there is no general chemical test for poisons, and many poisons cannot be tested for chemically at all.

Points to Consider Before Sending Samples for Analyses

There are hundreds of poisons that might possibly be present in a feed. As was stated, no single chemical test can be used to test for these. In other words, there is no chemical method to "test for poison," but rather a separate test must be used for each type of poison. Each test is time consuming and difficult.

Given an accurate description of symptoms and of conditions surrounding the case of suspected poisoning, the veterinarian can tell the chemist what type of poison to look for and much unnecessary work is eliminated. Where the description of symptoms is missing or incomplete, the chemist must resort to biologic tests, that is, feeding or injection of laboratory animals. At this laboratory, white rats are used for this test, and the results are subject to error (because these animals differ from farm poultry and livestock in their susceptibility to poison),

but they may help in deciding what poisons to look for by chemical analysis.

Because of the cost of analytical work, a search for poisons must be limited to a few possibilities. With complete information only one or two tests are necessary. With incomplete information, it is not advisable to undertake any work at all since the search is then much like "looking for a needle in a haystack." It should be kept in mind that it does not take many analyses to equal in cost the value of the livestock lost in many cases, or the cost of the feed in question.

In some cases, it is impossible, because of lack of facilities or methods to test for certain poisons in feeds at this laboratory. Some examples of this are as follows:

1. Trichloroethylene-treated soybean oil meal toxicity.
2. Poisonous plants of several types (identification of the plant is, however, helpful).
3. Botulism toxins.
4. Unknown toxins such as in cornstalk poisoning.

In the above cases, symptoms and conditions are the only means for determining the nature of the poison. In still other cases, the sample sent in may be so small that only limited chemical examination can be made. The sample may, therefore, be exhausted before any poison is found.

Finally, after an analysis has been made, the results themselves do not prove or disprove a case of poisoning. The results obtained must be interpreted and this is sometimes a very difficult task. It should be left to a veterinarian.

Sources of Poisons

It may be helpful to consider what one should look for as a source when poison is suspected. Some possibilities are listed below:

1. Rat poisons (there are several types of these)
2. Discarded paint pails (may be cause of lead poisoning)
3. Lubricating greases (may cause X disease)
4. Treated grain (mercury poisoning)
5. Caustic materials such as lye
6. Arsenicals (grasshopper bait, spray materials)
7. Insecticides
8. Pitchy or tarry substances (battery cases, tarred roofing paper)
9. Fertilizers (sources of nitrates)
10. Salt brines (especially those containing nitrates)
11. Decaying organic matter (may cause botulism)
12. Cornstalk poisoning (See Farm and Home Research, Volume V, No. 1)
13. Nitrate poisoning (See Bulletin 424)
14. Selenium poisoning (See Bulletin 311)
15. Poisonous plants
16. Prussic acid poisoning (See Technical Bulletin 1)
17. Scabby barley or other small grain (may poison pigs)
18. Water with excessive algae (water bloom)
19. Moldy sweet clover hay or silage (sweet clover disease)

In addition to the above, there are several other sources or types of poisoning that could cause trouble. On the other hand, there are some things that are often suspected in cases of livestock losses yet seldom, if ever, cause them. Some of these are as follows:

1. Commercial feeds or supplements
2. Natural waters of high salt content
3. Moldy feeds, except sweet clover (See below)

Moldy Feeds Can Be Checked

In many instances where livestock or poultry losses occur, feeds having a moldy appearance or smell are being used. The question arises then as to whether or not the mold is causing the trouble. There are usually a great number of kinds of molds present in feeds. Most kinds are harmless and a few are helpful; a very few are toxic or infectious. It is possible that some losses due to using moldy feeds have occurred, so some caution is necessary in feeding them. However, the results of experimentation and observations by several laboratories have shown that if livestock losses do occur from feeding moldy feeds, they occur very rarely. The exception to this is moldy sweet clover hay or silage which should be fed only as directed by a qualified veterinarian.

Since all feeds contain mold, a mere examination for their presence is of no value. To obtain definite information as to whether livestock or poultry losses resulted from molds in the feed, an examination for kinds of molds is necessary. This is such an involved procedure that it should only be undertaken when losses are experienced by enough farmers to warrant such research.

The feeder, himself, may have the best facilities for checking the toxicity of moldy feeds. This is especially true for poultry raisers. Feeding three or four birds the suspected feed and three or four others another feed, and making careful observations for signs of toxicity, is a rather reliable test for toxicity. The birds on the control (not moldy) feed are necessary, since if

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Wood Shingle Damage
1. Loose
2. Decayed
3. Warped
4. Split
5. Broken
6. Charred
Roof Leaks

THE ROOF OVER YOUR HEAD

By DENNIS L. MOE

"RAISE THE ROOF" is an old saying which should not be passed off lightly when it applies to wood shingle roofs on farm buildings.

Farmers lean more towards using wood shingles than city residents, because wood shingles are still the longest lasting type of roofing commonly used in this area. Also, wood shingles on farm buildings, which are more exposed to wind and hail, suffer less damage than other types of roofing.

A savings could be made by farmers and ranchers each year if infor-

mation on installation and upkeep of wood shingles would be available. Some questions concerning these shingles have been answered in a regional study on building materials. The technical staff of the North Central Regional Research Committee has set up recommendations for the best roof, as well as for a good serviceable shingle roof. Information was obtained on methods of installation of the shingles, and certain other building characteristics pertinent to the performance of the material, such as the

slope of roof, length of shingle, condition of sheathing, types of nails, and over 20 other items.

Recommendations for Wood Shingle Roofs

The *best* wood shingle roof should be of cedar shingles and should have the following characteristics:

1. An edge grain, 5/2 thickness, 18 inches long, width 6 to 8 inches, stained, and exposure not over 4½ inches;
2. A rise of 8 inches and above per foot run on roof slope;
3. A good quality white or yellow pine sheathing, either spaced or solid, with building paper between the sheathing and the shingles;
4. Nails, either plain or galvanized, long enough to penetrate the sheathing, with two used per shingle, spaced about 5 inches apart from the edge of the shingle.

A *good serviceable* wood shingle roof would have the following characteristics:

1. An edge or flat grain, 16 inches long, any standard thickness, any width, no treatment and exposed up to 5½ inches;
2. A pitch as low as 4 inches rise per foot run (possibly lower);
3. A sound quality sheathing of any wood species, solid or spaced with building paper between it and the shingles;
4. Nails, either plain or galvanized, long enough to go through both shingles and sheathing, with two nails per shingle about one-half to three-fourths inch from the shingle edge and using three nails in extra wide shingles.

Performance of Wood Shingle Roofs Inspected

Over 700 farm buildings were visited in the 12 states cooperating, to observe the actual performance of wood shingles in use. Of the types of buildings inspected, 49 percent were barns, 5 percent residences, 8 percent granaries, 8 percent corn cribs, 5 percent hog

houses, 10 percent poultry houses, and 15 percent other types of buildings. The average age of all wood shingles inspected was 23 years.

No significant difference was noted in the performance of the wood shingles for the various types of buildings, except that residences showed a smaller percentage of roof leaks than other buildings. It can be pointed out, however, that residence roofs show a smaller percentage of leaks for the following reasons: (1) better grade shingles are used on houses, (2) greater care is exercised in the construction of homes and (3) greater promptness exists in repairing leaks in roofs on residences than on roofs of other farm buildings.

The condition of the shingles at the time of inspection was measured by the presence or absence of different types of damages or failures. "Failure" as used in this study means some type of damage to the material but not necessarily a total failure. In a few cases it could be the natural deterioration with age of the material.

Damage to wood shingle roofs was divided into six types. They were: (1) roof leaks, (2) loose shingles, (3) decayed shingles, (4) warped shingles, (5) split and broken shingles and (6) burned or charred shingles. Some type of damage or deterioration was present in 81 percent of the roofs inspected.

Most Common Roof Failures Due to Wind or Faulty Application

Loose, split, and broken shingles were the most common failures. It was found that this was caused

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One of the classrooms in the Castlewood elementary school where the surroundings are light and pleasant, the desks fit the children, and there's a place for books and exhibits.

A Better Education

SOUTH DAKOTANS are beginning to realize that changes must be made in the organization of their school districts and in the variety of courses offered in the schools, if the youths of the state are to have the educational advantages they need. School buildings and facilities planned for other years and for a different distribution of population are not adequate to provide the program of courses needed today in many of the high school districts.

As recently as 1950, about one-fourth of South Dakota's high schools had only three teachers and more than 50 percent had six or fewer teachers. This means that these schools must necessarily offer a limited number of courses and extra-curricular activities. A minimum high school program requires at least six full-time teachers. This is not an arbitrary statement, but one based on the demands of today's living.

The educational needs of those who choose agriculture as an occupation are much greater today than they were even 20 years ago. Agriculture is now more than just production and hard work; it is a competitive business that calls for an interpretation of conditions over and beyond the local situation. It demands an understanding of markets, trends, and basic factors operating in our economy. Furthermore, from 40 to 50 percent of farm youth may be expected to move to urban communities. This means that high schools have the responsibility of preparing young people today to meet competition for occupations in cities as well as the type of competition that exists in agriculture.

Farm People Realize Importance of High School Education

It is evident that farm people have been realizing the importance of a high school education for boys and girls. From 1940 to 1950, there was a significant increase in the

number of persons, 25 to 29 years old, who had completed one or more years of high school (Table 1). The greatest increase, 19.7 percent, was for the rural farm men; it was high, 12.5 percent, for rural farm women.

Also, from 1930 to 1950, there was a general increase in all economic

Table 1. Percent of South Dakota Population, Ages 25 to 29, by Sex, in 1940 and 1950, Who Had Completed One or More Years of High School

| Residence | Ages 25 to 29 | |
|-----------------------|---------------|--------|
| | Male | Female |
| South Dakota | | |
| 1940 | 38.3 | 46.7 |
| 1950 | 50.0 | 55.1 |
| Urban | | |
| 1940 | 49.1 | 56.7 |
| 1950 | 49.1 | 59.1 |
| Rural-nonfarm* | | |
| 1940 | 42.6 | 47.5 |
| 1950 | 51.6 | 54.9 |
| Rural-farm | | |
| 1940 | 30.1 | 38.4 |
| 1950 | 49.8 | 50.9 |

SOURCE: U. S. Census, 1940 and 1950.

*The Rural-nonfarm classification represents town centers with fewer than 2,500 people.

... FOR YOUR CHILDREN

By DOUGLAS CHITTICK

Since 1948, the reorganized Castlewood school district has had a seven-teacher high school which offers a variety of courses for 91 town and country high school students.



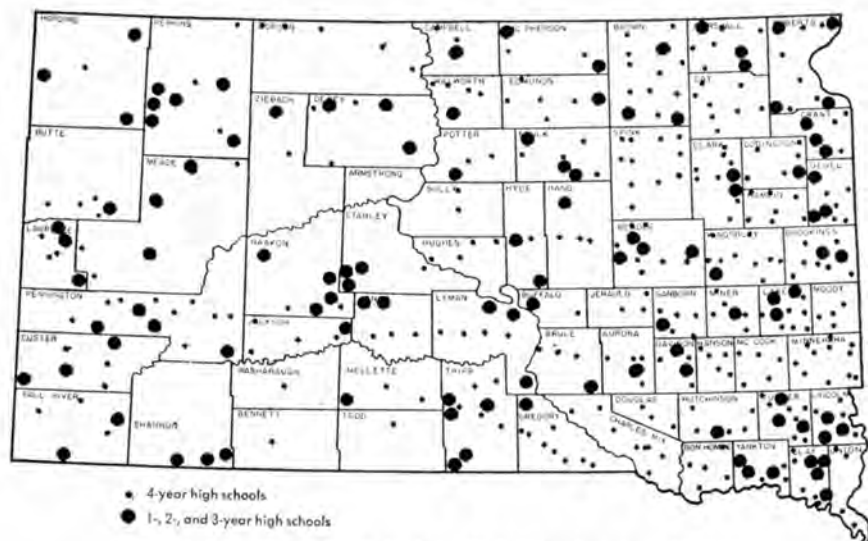


Fig. 1. Location of South Dakota High School centers, 1930-31

areas of the state (see maps for areas) in the percent of those 14 to 17 years of age who attended school (Table 2).

Table 2. Percent of Population 14, 15, 16 and 17 Years Old Attending School by Economic Areas in South Dakota for the Years Indicated*

| Years | South Dakota | | Economic Areas† | | | | | |
|-------|--------------|----|-----------------|----|----|----|----|----|
| | 1 | 2a | 2b | 3a | 3b | 4a | 4b | |
| 1930 | 76 | 78 | 77 | 78 | 75 | 72 | 74 | 76 |
| 1940 | 80 | 81 | 76 | 83 | 80 | 77 | 77 | 83 |
| 1950 | 83 | 85 | 87 | 83 | 83 | 80 | 77 | 87 |

SOURCE: U. S. Census, 1930, 1940, 1950.

*See Fig. 2 for the location of the seven different economic areas in South Dakota.

†The 1950 U. S. Census of Agriculture groups those counties in South Dakota having similar agricultural, demographic, climatic, physiographic and cultural characteristics as economic areas.

Elementary school enrollments have been increasing in the small town centers. Since rural schools have been closing at the rate of about 68 a year, assignment of these rural pupils to town centers, plus the general increase in birth rates, has overcrowded many of these schools.

School Buildings Overcrowded and Inadequate

Many children in school now are using the combined elementary and secondary school buildings that were used as early as 1900. These buildings were constructed at a time when there was an entirely different population distribution from that which now exists. For instance, since 1930, rural farm population has decreased by about 35 percent, and between 1940 and 1950, population centers of 1,000 or more have been increasing in size while those less than 1,000 have been decreasing.

School building construction and renovation have not kept pace with population changes. The State Constitution provides that districts cannot be bonded for more than 5 percent of their assessed valuations. This means that many of the larger places, where more and more students attend school, cannot build

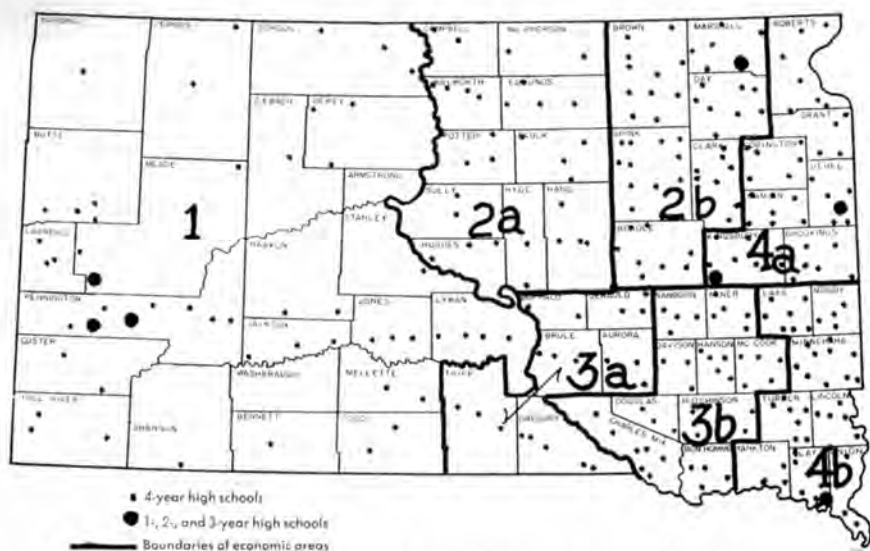


Fig. 2. Location of South Dakota High School centers, 1950-51

additions even though they have the wealth, and small schools do not have the supporting population or the wealth to rebuild or make improvements needed.

The larger school centers are likewise overcrowded. The trend for people to live in places of 1,000 or more, increased birth rates in these places, and the increasing proportion of those of high school age attending the larger schools, are responsible for this.

An understanding of the distribution of high schools of South Dakota will help to interpret present educational needs. (Figs. 1 and 2, and Table 4).

Distribution of High Schools in Light of Present Educational Needs

There has been very little change in the number of high school centers offering a 4-year course in the last 20 years: there were 285 in 1930, as compared to 278 in 1950.¹

The greatest change during this 20-year period was in the 1-, 2-, and 3-year high school centers: 114 in 1930 and only 7 in 1950.

The number of 1-, 2-, and 3-year high schools was quite evenly distributed throughout the state in 1930, in spite of the fact that there is a wide difference between the East and West River areas in the density of population (Fig. 1). Their disappearance was directly related to the decline in the supporting rural population, improved transportation facilities, and an increase in the number of students who chose to attend schools which had broader course offerings. The disappearance of these schools foreshadows the clos-

¹Figures 1 and 2 were prepared on the basis of the availability of high schools, not on the number of high schools. Those places having a public high school were included, but Indian and parochial schools were not counted in these places; however, parochial and Indian schools were counted as centers operating high schools if no public high school was located at the place and if educational privileges were open to all regardless of race or religious affiliation.

ing of many small 4-year high schools for the same reasons.

It is quite obvious that the 4-year high schools continue to be located according to the pattern of main highways in the state, indicating the influence of transportation. County seat towns are, for the most part, the large towns in South Dakota, so there is a good distribution of the large high schools over the state. The smaller high schools, then are distributed over the state in areas between county seats and larger places. This means that many of the schools in the larger places are experiencing housing difficulties, and discouraging tuition attendance. Some of the smaller schools have increased their bus service, perhaps to the point of diminishing returns, in order to recruit a sufficient number of students to justify operation of a school.

There was, on the average, only one high school in Area 1 for each 762 square miles (Table 3), and yet 85 percent of the young people 14 to 17 years old attended school (Table 2). The percent of school at-

Table 3. Number of Square Miles Per Population Center Having a 4-Year High School in South Dakota in 1951, by Economic Areas

| State Total | Economic Areas | | | | | | |
|----------------|----------------|-----|-----|-----|-----|-----|-----|
| | 1 | 2a | 2b | 3a | 3b | 4a | 4b |
| 311 | 762 | 327 | 144 | 274 | 135 | 125 | 102 |

tendance in Area 1 is almost as high as that in Area 4b, where there was a high school for each 102 square miles (Fig. 2).

Increasingly larger numbers of high school students are being transported to schools in all areas; however, the problem is that many are attending high schools having three or four teachers offering a very limited program of studies.

A classification of 4-year high schools on the basis of the number of teachers is especially meaningful when it is considered in relation to their location in the state (Table 4).

School District Reorganization Under Consideration

At the present time, approximately 20 counties are re-evaluating their educational needs in the light

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Table 4. Number of High Schools and Enrollment Classified by Number of Teachers, 1950-51

| Number of Teachers* | Number of Schools | Enrollment | | | |
|------------------------|----------------------|------------|---------|--------|---------|
| | | Total | Average | Lowest | Highest |
| 3 | 82† | 2,782 | 34 | 14 | 58 |
| 4 | 43 | 2,302 | 54 | 27 | 82 |
| 5 | 32 | 2,244 | 70 | 24 | 106 |
| 6 | 32 | 2,684 | 84 | 46 | 129 |
| 7 | 25 | 2,552 | 102 | 77 | 165 |
| 8 | 13 | 1,431 | 110 | 40 | 149 |
| 9 | 9 | 1,199 | 133 | 86 | 176 |
| 10 | 6 | 815 | 136 | 85 | 173 |
| 11-20 | 27 | 6,259 | 232 | 54 | 359 |
| 21 and over | 9 | 7,131 | 792 | 374 | 1,993 |
| | 278 | 29,399 | | | |

SOURCE: *Educational Directory of South Dakota Schools*, State Department of Public Instruction, Pierre, S. Dak., 1950-51.

*One school has two teachers.

†Includes Superintendents, Principals, and Supervisors.



Equalizing *your* FARM PROPERTY *Tax*

By JOHN THOMPSON and
MAX MYERS

REAL AND PERSONAL property taxes take a large portion of farm profits in South Dakota and constitute an important part of the total farm operating costs. A good understanding of the present tax system will help the taxpayer to judge the adequacy and equality of the system and pave the way for some needed improvements.

Several inequalities in the present system of levying taxes have been found to exist and are pointed out in research done by the Agricultural Economics department. The reason for these shortcomings may be the fact that the tax system has "accumulated" rather than developed as a result of planning.

One of the obvious inequalities in our system is evident in the field of farm property evaluation for taxation purposes.

Farm Real Property Taxation

Farm real estate taxation in South Dakota gives little or no consideration to the productive capacity of the various lands or the buildings on that land. If it is believed that taxes on real estate should be levied in accordance with the ability of the property to produce, a more equitable farm real estate tax system should be worked out in this state.

In some townships every acre of farm land is assessed at the same dollar figure, despite great variations in soil types, productivity, or location. An example of the in-

Table 1. Assessments Levied for Selected Counties, 1952

| | Assessed Value per Acre | Levy Mills | Average Tax Per Acre |
|--------------------------------|----------------------------|------------|-------------------------|
| Beadle County | | | |
| South tier in Bonilla Township | \$21.72 | \$42.50 | \$0.92 |
| North tier in Allen Township | 18.76 | 29.09 | 0.54 |
| Hand County | | | |
| South tier in Alpha Township | 12.43 | 31.27 | 0.38 |
| North tier in Miller Township | 18.74 | 29.76 | 0.56 |

equality that exists in tax levies on rural lands can be observed in Table 1, which compares the average taxes levied per acre in 1952 on land in different townships, separated only by a road.

As further evidence of the inequality in tax payments on farm

all property shall be assessed at its true and full value in money. This stipulation is not being complied with. For example, in 1952, in Hand County, St. Lawrence Township, 38 sets of farm buildings were assessed at less than \$1,000 with none above that figure. In Miller Township, 38 sets of farm buildings were assessed above \$1,000 (the highest \$1,308) and 43 sets were below \$1,000. It is obvious that in some of these cases farm buildings are grossly under-assessed. This is, in general, true of farm assessments and non-farm assessments over the state.

Under-assessment as such does not necessarily mean that there will be, or is, inequality in tax payments. However, it does tend to make it more difficult to determine equality between properties.

Farm Personal Property Taxation

An important part of farm property tax payments is due to levies placed on the personal property of farmers and ranchers. In the eastern areas of the state, personal property tax revenue comes mainly from farm machinery and livestock, while in western South Dakota, the bulk of such taxes is obtained from livestock assessments—mainly cattle.

The inequality that exists in farm personal property taxation is most

Table 2. Tax Bills per \$1,000 Assessed Valuation for Selected Counties, 1950

| Counties | Lowest | Highest |
|-----------|---------|---------|
| Brookings | \$14.00 | \$34.65 |
| Beadle | 19.97 | 40.95 |
| Clay | 15.28 | 27.53 |
| Haakon | 12.66 | 32.66 |

property one can compare the highest and lowest tax bills per \$1,000 of assessed valuation in selected counties in South Dakota (Table 2). These comparative assessments for 1950 apply to rural school districts in their respective counties.

Our present method of assessment of farm buildings is another case where inequality of tax levies is very apparent upon investigation. As was previously mentioned, little consideration is given to the income earning capacity of farm buildings in levying procedures. A method for making an equitable comparison between buildings on different farms is also much needed. The South Dakota law says in effect that

Table 3. Farm Taxpayers Who Live in a School District Which Includes Town Taxpayers Are Penalized by the Present Property Tax System

| State Tax Item Number | Classification of Property Assessed | Town Taxpayer Whose Income Depends Entirely Upon His Wages | Farm Taxpayer Whose Income Depends Entirely Upon His Business Investment |
|-----------------------|---|--|--|
| | Which in These Instances Are Assumed to be | \$3,000.00 | \$3,000.00 |
| A1 | Agricultural land outside corporate limits, improvements and structures on same | | 915.19 |
| D1 | City and town lots and improvements on same | 1,323.78 | |
| 14½ | Electric refrigerators, residence, 1 @ \$86.86 | 86.86 | 86.86 |
| 16 | Radio sets, 1 @ \$20.06 | 20.06 | 20.06 |
| 22 | Household furniture, rugs, provisions, etc. | 203.39 | 203.39 |
| 1 | Horses and mules, 2 @ \$22.73 | | 45.46 |
| 2 | Cows, all ages, 75 head @ \$67.51* | | 5,063.25 |
| 7 | Bulls, 2 @ \$146.99† | | 293.98 |
| 10 | Tractor, small 2-3 plow 1 @ \$440.65 | | 440.65 |
| 20 | Agr. implements, tools, machinery, harness, saddles, wagons‡ | | 100.00 |
| A | Agr. land, outside corp. limits, 1500 acres @ \$3.00 per acre§ | | 4,500.00 |
| | Total | 1,634.09 | 11,668.84 |

NOTE: Assessment valuations for each state tax item number are State Division of Taxation Averages, except in the last two items.

*75 cows with an 80 percent calf crop would produce 60 calves at a market value of \$50.00 each, thereby producing a gross income of \$3,000.

†2 bulls would be necessary for 75 cows.

‡No state averages are available for this item, so an estimate was supplied.

§The state average for agricultural land is \$14.80. Since a cattle ranch represents a typical western South Dakota farm situation, and since the assessed valuation per acre is much lower in this area, a valuation of \$3.00 per acre was placed upon this land. It is estimated that it takes 20 acres of land to feed one cow per year.

apparent when one considers the total taxation of the farm enterprise, a considerable portion of which is personal property levies, and compares these tax levies with the personal property taxes paid by other occupational groups. This inequality may best be observed in the table prepared by the Department of Public Instruction, Pierre, South Dakota (Table 3).

It must be emphasized that this table does not present the total tax picture between these two occupational groups. Rather it is a hypothetical case pertaining only to a selected property tax situation. It does, however, suggest that considerable inequality exists in personal property tax assessment between the two groups, especially if the

view is held that taxes should be levied in accordance with net profit returns.

Suggestions for Obtaining Equality in Farm Property Taxation

Improving assessment practices may go a long way in attaining the desired equality in assessments of the three types of farm properties—farm land, buildings, and personal property.

On farm lands a method has been devised whereby land can be given a productivity rating in accordance with its soil analysis, slope of land, stoniness, rate of precipitation, drainage, roads, and land use. Using such a rating procedure in making comparative levies on land is one way of getting more equality in land assessments.

Farm buildings may also be more fairly assessed if more consideration is given to the use of the buildings, condition and size of buildings, type of construction and how such buildings fit in with the total farm program.

To approach equality in farm personal property assessment seems to be much more difficult than is the case for either land or farm building assessments. To make an accurate or equitable assessment of such items as jewelry, art objects, securities and money, plus a host of other obscure, but oftentimes expensive items, is probably more of an ideal than actually attainable.

Another proposal that may prove to be of considerable importance in our assessment practices and in equalizing farm property taxation, is that of providing for a full-time county supervisor of assessments or county assessor.

The object of such a proposal would be to obtain more equality through a more accurate and complete system of assessments. The qualifications of such an official, as an authority in evaluation of property and getting property rated equitably, should contribute to this desired objective.

A bill was introduced in the legislature of this state to create and es-

tablish the Office of Supervisor of Assessments or County Assessor. It failed to pass. Such a bill will probably be introduced again at the next legislative session.

Taxation System Can Be Improved

The system of taxation in South Dakota can be much improved. Equalization of the farm property tax burden would be an important move toward such an improvement. Equalization of taxation does not necessarily mean that more revenue will be obtained, but rather that the burden of tax obligations will be more fairly distributed.

A system of tax assessments on farm land and buildings in accordance with the productive capacity of such property would go a long way in equalizing farm taxes on real estate between farms. It would be difficult to equalize assessments of farm personal property either between farmers or between farmers and urban residents.

Providing for a supervisor of assessments or a county assessor, qualified in property evaluation and equalization procedures, would be another method of attaining more equality in farm tax assessments. (Project 240. Leaders: M. Myers and J. Thompson, Agricultural Economics Dept.)



Effects of Antibiotics **on PORK CARCASSES**

By ELLIS A. PIERCE

CERTAIN ANTIBIOTICS promote faster growth and increase feed efficiency when fed to pigs during the growing-fattening period from weaning to market weight. However, the effects of antibiotic supplemented rations on the carcasses of these faster growing pigs have not received a great amount of study, and the results of studies which have been conducted are somewhat contradictory.

Antibiotic Supplements Included in Rations

During 1951-52, an experiment was conducted at this Station to determine the effects of rations containing aureomycin - vitamin B₁₂, terramycin, and trace mineral salt on the chemical composition and physical characteristics of the carcasses produced from hogs weighing approximately 200 pounds.

To obtain the data for this study, 46 barrows were slaughtered. These had been fed in six different dry lots and averaged 209 pounds at time of slaughter. The pigs in Lot 1 were used as controls. The pigs in Lots 2 and 3 received an aureomycin-vitamin B₁₂ supplement, and those in Lots 4 and 5 received a terramycin supplement. In Lots 2 and



Average backfat thickness of the pigs receiving an antibiotic was slightly higher than that of the pigs not fed antibiotics.

4 the antibiotic supplement was included in the ration during the entire feeding period, whereas in Lots 3 and 5 it was discontinued when the pigs averaged about 125 pounds in weight. Lot 6 pigs received the trace mineral salt.

The hogs were slaughtered in the college meat laboratory and the carcasses chilled for 24 hours. Previous to cutting, an appraisal was made of the physical characteristics by taking measurements, such as carcass length from the first rib to the front end of the aitch bone, and backfat thickness at the first and last ribs and last lumbar vertebrae. Then, the right side of each carcass was cut into wholesale cuts and the

Table 1. Summary of Carcass Measurements

| | Lot 1 Control Lot Basal Ration | Lot 2 Aureomycin Vitamin B ₁₂ to 200 Lbs. | Lot 3 Aureomycin Vitamin B ₁₂ to 125 Lbs. | Lot 4 Terramycin to 200 Lbs. | Lot 5 Terramycin to 125 Lbs. | Lot 6 Trace Mineral Salt |
|--|--|--|--|---------------------------------------|---------------------------------------|-----------------------------------|
| Number of pigs | 6 | 9 | 8 | 8 | 8 | 7 |
| Average live weight at slaughter, lbs. | 208.8 | 211.7 | 210.2 | 207.9 | 207.2 | 207.4 |
| Average dressing percent | 74.4 | 77.0 | 76.7 | 76.4 | 76.6 | 76.8 |
| Average length of carcass, inches* | 28.9 | 28.3 | 28.1 | 28.8 | 28.8 | 28.7 |
| Average depth of back fat, inches† | 1.78 | 1.94 | 1.97 | 1.82 | 1.87 | 1.79 |
| Average weight of four lean cuts, lbs. | 32.9 | 33.5 | 33.0 | 33.3 | 34.0 | 33.0 |
| Average weight of fat cuts, lbs.‡ | 12.0 | 13.5 | 13.4 | 12.9 | 12.6 | 12.8 |

*Measurement made from first rib to point of atch bone.

†Measurements taken at first and last rib and last lumbar vertebra.

‡Includes backfat and clear plate.

weights of the lean and fat cuts were recorded and used as an additional standard for judging physical characteristics. A summary of the carcass measurements taken is presented in Table 1.

Protein, Fat and Moisture Content

The protein, fat, and moisture content of each carcass was determined by chemically analyzing representative samples of the lean and fat tissue obtained from the ham, loin, and shoulder by physical separation. Results of these analyses revealed some interesting variations in moisture and fat content of the lean tissues depending upon their location in the carcass. The ham lean tissue contained 68.5 percent moisture as compared to 62.3 percent for the loin lean tissue. Differences in fat content were even more pronounced and gave percentages of 8.8 and 15.3 respectively, for the ham and loin. This represents a variation of approximately 75 percent in fat content for the two cuts and would indicate a much lower calorie content for the lean from the ham when compared with an equal amount of lean from the loin.

No Effects on Hog Carcasses Produced by Antibiotics

The results show that the average backfat thickness of the pigs receiving an antibiotic was slightly higher than that of the pigs in the control lot and caused a corresponding increase in the average weight of fat-back and clear plate. However, neither analysis was significantly different and therefore may have been due to chance alone. The average weight of lean cuts was very similar in all groups, and there were no apparent differences between lots due to the length of time that the antibiotic supplements were supplied in the ration.

Chemical composition analyses revealed no differences between the various lots which could be attributed to the feeding of antibiotics.

It was concluded that adding aureomycin-vitamin B₁₂, terramycin, or trace mineral salt in the growing-fattening ration produced no measurable effects on the chemical composition or physical characteristics of carcasses from hogs weighing approximately 200 pounds. (Project 214. Leader: Ellis A. Pierce, Animal Husbandry.)

Analyzing Feeds for Poison *Continued from page 59*

disease is the cause of the trouble, they and the birds on the suspected feed will both show symptoms. This test can obviously be used only to a limited extent with pigs and cattle because of the cost of the animals.

Charge for Analyses

A charge, representing only a fraction of the actual cost, is usually made for analytical work done at

this laboratory. In cases of hardship (where costly livestock or poultry losses have occurred) the charge is not made, provided there is sufficient evidence (symptoms and conditions) of poisoning forwarded with the sample or samples. (Project 241. Leaders: O. E. Olson, Biochemistry, and C. W. Carlson, Poultry.)

The Roof Over Your Head *Continued from page 61*

mainly by wind or faulty application and not because of too great an exposure of the shingles. It is often believed that if too great an area of the shingle is exposed this will cause trouble, but the study showed that shingle exposure of 4 to 5 inches is not too great.

Wood shingles are only one of 10 materials included in the regional study which is concerned with the selection and utilization of materials for farm building construction. Work on a building materials handbook has been underway for a number of years and the information on the wood shingles is the first to be completed on a regional basis.

More Than 100 Farm Buildings Inspected in South Dakota

In South Dakota, 101 farm buildings located on 62 different farms were inspected. Observations were conducted in both East and West

River areas. The types of structures inspected were residence, movable poultry brooder house, central poultry house, central hog house, granary, general purpose barn, sheep barn, dairy barn, milk house, implement storage house and garage. The building sizes varied from a small movable building to a very large barn of 10,000 cubic feet.

Regional approach to the subject of building materials seems satisfactory because factors such as climate, topography and type of agriculture, which influence building requirements, cut across state lines and are regional in character. The buildings materials handbook including the technical information will be available soon. A popular version of this technical bulletin will also be available in the near future. (Project 203. Leader: Dennis L. Moe, Agricultural Engineering Dept., cooperating with NC-23.)



Precautions When Using Chemicals *Continued from page 51*

ever, this chemical should never be applied near buildings or other inflammable structures.

Sodium chlorate is also corrosive to metals, especially iron, and is therefore not adapted for use along railroad tracks or other iron structures. This means that sprayers in which sodium chlorate has been used should be thoroughly washed to keep from impairing the operation of the sprayer. (This also applies to amate when it is used.)

In the last few years sodium chlorate has been mixed with borax compounds. These mixtures are not inflammable and are not corrosive to metals. In some areas where sodium chlorate is needed to control the weeds, but where fire hazards are great, it may be advisable to use one of these mixtures.

CMU May Damage Soil

CMU is not readily soluble in water. It is usually applied to the soil and acts as a soil sterilant, but it does not do a good job of killing weeds unless the soil moisture content is high and there is an abundance of rainfall after the chemical is applied. Disappointing results will be obtained if there is not an abundance of moisture.

Small amounts are sometimes applied to kill grassy weeds in crops. The present crop may not be injured, but there is a limited amount of data which indicate that the chemical moves down 6 or 8 inches in the soil and stops. There is the possibility that several light applications applied over a number of years might accumulate in large

enough quantities to kill a crop when its roots reached the concentration of chemical. Therefore, it is not advisable to use this chemical on cropland.

Arsenic Poisonous

Arsenic compounds are not recommended for weed control in South Dakota. However, arsenic trioxide is used as a soil sterilant by some industrial firms. It is a good soil sterilant, but is poisonous to humans and animals. Livestock do not normally eat the white powder, but care should be taken not to let them graze foliage that has been treated. Much of the danger to livestock can be overcome if the chemical is applied when there is little or no vegetation on the soil, or by mowing the foliage before the chemical is applied. Danger to the individual making the application can largely be overcome by using a non-dusty form, such as a wettable powder or pellets.

No Need to Fear Use of Chemicals

Even though weed chemicals are dangerous, there is no need to be afraid of them. A tractor or a corn picker is also very dangerous. However, farmers learn how a machine works, what precautions to observe in its use, and how to use it to advantage. The same can be done with weed chemicals.

Complete descriptions of the most important weed killers and their uses are given in Circular 102, "Weed Control," which can be obtained at the county agent's office or at the Agricultural Experiment Station, South Dakota State College. (Project 32, Agronomy Dept.)

Better Education for Your Children *Continued from page 66*

of South Dakota's school district reorganization law.

The purpose of school district reorganization is, first, to provide an adequate educational program to prepare young people to take their places in an increasingly complex society in either rural or urban areas; and second, to determine the size of the area which will provide for the best balance of enrollment, assessed valuations, and transportation to insure such a program.

Often some of the first inquiries about reorganization are whether it will increase the taxes and improve the schools. It has been found in many cases that the taxes were raised in some of the former districts and lowered in others, but that the total cost of education in the reorganized district was decreased, or no higher, if no improvements in buildings, staff and curriculum were made. Inasmuch as "you get what you pay for," additional courses, improved facilities, and better trained teachers cost more, proportionate to the improvements; however, this cost is spread over a wider base in properly reorganized districts.

In a study of 552 reorganized districts in eight widely separated states, it was found that the five subjects added most frequently in reorganized districts of 300 or fewer students were: agriculture, home-making, industrial arts, music, and driver education.² This study reveals that many additional courses and services were added in the larger reorganized districts. However,

the courses added with reorganization do not tell the whole story. One of the principal values comes with the increased teaching staff in the larger schools who are trained and specialized in their respective fields. Not often is it possible to find the right combination of three teachers in a 3-teacher high school who have had preparation and training in all of the course areas a high school should offer.

What Is an Ideal School District?

School authorities have made studies to determine an ideal school district. It was found that conditions do not often exist for ideal school districts, and this would be especially true in a sparsely settled state like South Dakota. What might be considered ideal from the standpoint of cost may involve such a large enrollment and total population that there would be a loss of local interest. Further, an ideal enrollment in sparsely settled areas would necessitate such a large district that transportation would not be practical.

There is general agreement among authorities that, for administrative purposes, an ideal school district should include all grades from kindergarten to grade twelve, and the total enrollment should be over a thousand pupils. If there were a teacher for every 25 to 30 pupils, this large an enrollment would require a minimum of 35 to 40 teachers. There is a limit, of course,

²*Educational Change in Reorganized School Districts*, Bulletin No. 4, U. S. Department of Health, Education, and Welfare, Office of Education, 1953.

to the size of the enrollment in the district. Some authorities have set this figure as high as 10,000.

Another limitation on the size of the attendance area is the matter of transportation. Authorities generally agree that the number of busses and bus routes should be organized so that elementary pupils are not on the bus more than 45 minutes and high school pupils not more than one hour going either to or from school.

Most authorities agree that a district should include one or more town centers. One of the purposes is to insure a sufficient enrollment for a program from kindergarten through grade twelve. Another reason is to take advantage of the community of common interests that exists between the people in the open country and the town center. This may mean in many cases that one administrative unit may include a number of attendance areas. High schools should be organized on the basis of community areas while elementary schools should be established on the basis of neighborhoods.

Often a school district reorganization program proceeds on the basis of dividing the rural trade territory in a county among all the town centers. This practice is no doubt influenced by the assumption that a certain amount of the farm area surrounding a town center "belongs" to that town. Studies by rural sociologists, economists, and others have found that the trade and service areas of all population centers are constantly changing. For instance, the farm area around a small town "belonged" to the country

doctor in that town at one time. Now, however, this area as well as the town itself "belongs" to some larger place where specialized medical services as well as hospital are available. Changes in transportation in recent years have brought about changes in what "belongs" to different sized communities. Since secondary education is becoming more specialized, this means that high schools must be established where they can be supported socially and economically.

Determine Minimum Educational Needs First

A suggested approach to reorganization would be to determine the minimum educational needs first, and then consider the supporting area even though it may be necessary to include more than one town center and some farm area in adjoining counties.

As a point of reference, it can be assumed that a minimum high school program (grades 9 to 12 inclusive) should include:

1. Language Arts (English, Journalism, Speech, Foreign Languages)
2. Mathematics
3. Science
4. Social Studies (History, Government, Sociology, Economics)
5. Business Education
6. Vocational Agriculture
7. Industrial Arts
8. Vocational Homemaking
9. Music and Art
10. Health and Physical Education

If school plays, club activities, and a testing and guidance program are included, it would take at least seven full-time teachers to provide such a program. Perhaps six full-time teachers could carry out the work if the enrollment is small and

a program of alternating courses is followed.

As of 1951, South Dakota had 82 high schools with three teachers and 43 schools with four teachers; average enrollments were 34 and 54, respectively (Table 4). Sixty-four high schools had five and six teachers with an average enrollment of 70 and 84. These four classifications represented more than 50 percent of our high schools.

The solution to this problem is through reorganization. Some of the small high schools could incorporate a sufficient rural area surrounding them, disregarding county boundary lines, to provide adequate educational facilities. In other cases, two or more small communities could combine their areas to form one administrative unit and several attendance areas. Some small high schools could be closed. These suggestions seem especially feasible in view of the data in Table 5. Ninety-nine of our small 4-year high schools are within 20 miles of schools with six or more teachers.

The problem involves not only the small high schools. A good reorganization of the small high schools in interstitial areas will help solve some of the problems of the larger schools, because some rural students attending larger schools now would prefer going shorter distances to their own school if it provided an adequate program. These are questions to be decided by local

Table 5. Number of 4-Year High Schools Having 25 or Fewer Resident Students Within Specified Distances of High Schools with Six or More Teachers as of 1953-54

| Number of Schools | Number of Miles to High Schools With Six or More Teachers |
|-------------------|---|
| 41 | 6 to 10 |
| 36 | 11 to 15 |
| 22 | 16 to 20 |
| 5 | 21 to 25 |
| 5 | 26 to 30 |
| 109 | |

SOURCE: *Educational Directory of South Dakota Schools*, State Department of Public Instruction, Pierre, S. Dak., 1953-54.

residents on the basis of what kinds of schools they want. It should be pointed out, however, that the trends are toward larger, centralized schools and that this has been a trend that will continue slowly, at great cost to some districts, in spite of reorganization.

Some small schools contemplate the construction of a new gymnasium and other school buildings at great local sacrifices in the belief that such facilities have great holding power and will guarantee the continuance of a school. A short drive into the country in most areas in South Dakota will take one to any number of vacant rural school buildings. Many of these buildings are relatively new standard schools—some are brick structures. Their broken windows, depreciating playground equipment, and unkempt yards should be a reminder that such lack of foresighted planning is costly. (Project 219. Leader: D. Chittick, Rural Sociology Dept.)

A more complete discussion of the high school problem is contained in Pamphlet 117, obtainable from the Rural Sociology Department, Agricultural Experiment Station, South Dakota State College, Brookings.



Corn silage put up in open silos may contain a number of maggots in the spoiled layer. It is believed that these maggots of the European Scavenger fly will not be harmful to cattle in the feed.

Maggots

(Of the European Scavenger Fly)

FOUND INFESTING CORN SILAGE

By WAYNE L. BERNDT

WITH THE INCREASE in number of the open type silos, cases of silage infested with maggots will undoubtedly come to the attention of farmers and county agents. Recently, a farmer sent the Entomology department a sample of silage in which there was a number of "worms" or larvae, which were identified as maggots of the European Scavenger fly. The farmer was concerned whether these "worms" would harm his cattle.

The silo was an open trench type located in a well drained area, and the silage had been well packed. The maggots were found in the rotted layer along the edges of the silo at a depth of 10 to 15 inches. In looking for the infestation, several forkful of silage would yield no maggots, then the next forkful would have a pocket of infestation

with over a hundred maggots in it. The rotted silage was not being fed to the cattle and there was no sign of maggots in the sound silage. If any maggots were fed to cattle, there was no evidence that any harm had been caused the cattle.

Many farmers in feeding from such an open silo will use a manure scoop mounted on the front of their tractors, feeding all the silage and making no distinction between spoiled and sound silage. Such methods of handling would include large numbers of maggots in the feed, should they be present in the decayed layer. Reports of similar infestations by entomologists at Iowa State College indicated that silage containing large numbers of these maggots was fed to cattle with no apparent harm. (Project 220. Leaders: H. C. Severin and W. L. Berndt, Entomology Dept.)

Talking Over FARMER-DEBTOR RELIEF Legislation

By ERNEST FEDER and J. A. MUNGER

TO TALK about farm distress now when agriculture has just gone through a decade of nearly uninterrupted prosperity is good policy. It is widely recognized that the best time to set up permanent measures to prevent mass foreclosures and bankruptcies is when we have leisure to work out effective, well-balanced measures. Congress has lately considered several bills to give individual farmers relief when in financial distress. These bills are all in the form of a new chapter to the U. S. Bankruptcy Laws and are entitled: *Chapter XVI: Farmer-Debtor Relief*.

THE FRAZIER LEMKE ACT

Section 75 of the U. S. Bankruptcy Laws (the "Frazier Lemke Act") was passed in 1933 during the depth of the depression, amended in 1935 and renewed by Congress from time to time. This Act expired in 1949 and the question is being discussed as to the type of measure that should be passed by Congress to replace it. Its purpose was to "effectuate a broad program of rehabilitation of distressed farmers faced with disaster of forced sales and oppressive burden of debt."



The need for federal legislation was urgent, even in retrospect: foreclosures and bankruptcies were very numerous. Considerable unrest existed in many farm communities. For instance, in March 1933, a group of farmers marched to Aberdeen to prevent the local sheriff from foreclosing farms; creditors were afraid to hold public auction, and petitioned for private auction sales.

Section 75 provided for two methods of relief through an altered bankruptcy procedure: it enabled a farmer to ask his creditors for a compromise agreement under supervision of the court: for an "extension" of time for paying his debts; for a "composition" if the amounts of the

debts were to be changed, or for both.

If an agreement was not reached, he could ask for a judicial moratorium of three years. His farm was appraised at its "then fair and reasonable market value." He remained on the farm subject to rental payments. All proceedings against him were stayed with all "existing mortgages, liens, pledges or encumbrances (remaining) in full force and effect."

After, or during, the three years, the farmer could offer to pay the amount of the appraisal—or reappraisal—less payment on the principal. This "redemption," of course, was possible only where the farmer found a lender willing to loan the necessary funds. Upon payment of this amount, the farmer became owner of the farm, free of his old debts. However, a public auction could be requested by a secured creditor in which case the farmer had 90 days to buy back the farm; or the court would order the sale if the farmer was unable to refinance himself.

The Act has been the object of much discussion. It was hurriedly written. It took several years before the courts clarified and interpreted its provisions, but its legality was firmly established after several Supreme Court tests.

The actual operation of the Act and its effect on agriculture have, however, never been fully appraised. It is known that many lower courts, attorneys, and credit institutions were hostile to it, partly because of its new, then still unorthodox procedure; partly because it de-

prived creditors of the traditional method of enforcing their claims and forced them into a procedure, at the will of the debtor, resulting possibly in a financial loss to them which in some instances they believed, rightly or wrongly, they could have avoided. Nor is it easy to appraise the effects of the Act: in addition to its actual operation, its mere existence might have indirectly encouraged a creditor to agree to an arrangement with the farmer, in order to avoid the use of the Act.

Recent Congressional Bills

There are now two types of bills in Congress. One is similar in purpose and method to the expired Act; the other appears to be basically different.

The first bill, passed by the Senate three years ago, but not by the House, and still subject to consideration by Congress, is detailed and complicated. It follows broadly the former Act except that the moratorium is granted immediately after the farmer petitions for relief (See Table 1, Column 2). It is a *debt adjustment bill*, providing for possible "scale down" or adjustment of debts. But while it is apparently a bill for distressed farmers, it is written in unclear, cumbersome language so that farmers, agricultural economists, or extension workers can hardly understand its meaning—a serious and unnecessary shortcoming.

The other bill which was passed by the Senate both in 1952 and 1953 (but has not yet reached the House) is in the nature of a *federal moratorium bill*. It apparently deviates from former types of federal bank-

ruptcy legislation. It does not provide in principle for a debt adjustment, but only for a judicial moratorium. It follows a relatively simple procedure (Table 1, Column 3). Since there is no debt adjustment, there is no appraisal of the farm and no "redemption." At the end of the moratorium, the financial structure of the farmer, *i.e.* the amount of his original, secured debts, is basically unchanged. However, unsecured debts may apparently be scaled down.

While the inclusion of an "unlimited" moratorium appears to be a desirable measure, on closer examination the bill contains provisions which may cast doubt on its adequacy.

For example, the law does not require an appraisal of the farm, but in making an offer for rental payments the farmer must base his offer on the market value of the property. It is difficult to see how this can be done without making an appraisal. Or: if a farmer defaults in his rental payments, the court may end the proceedings if he does not pay up within two months (apparently a harsh provision and in contradiction to the purpose of the bill).

The bill's own language contradicts its declared purpose: its sponsors specifically stated that the bill is not intended to cover a "nation-wide emergency." However, in one

Fig. 1. Number of non-farm bankruptcies and farm bankruptcies (regular and s.75 cases) 1928-52. The number of cases is based on number of petitions to Federal court.

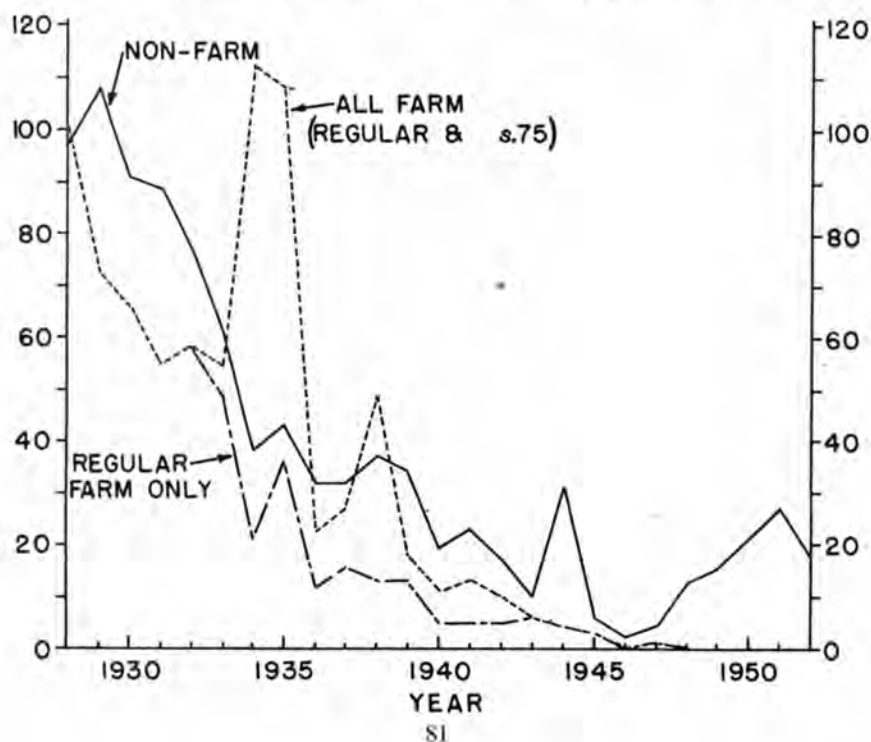


Table 1. Outline of Major Steps in Proceedings

| Frazier Lemke Law | Debt Adjustment Bill | Moratorium Bill |
|---|--|---|
| Petition for composition or extension. Owners and tenants, though tenants not mentioned. | Petition for relief probably for owners and some tenants. Farmer offers to pay rental. | Petition for relief by owners or tenants. |
| Appointment of Conciliation Commissioner acting on behalf of court to assist the farmer. | Appointment of referee and possibly trustee. Creditors meeting decides on merit of farmer's case. | Appointment of referee and three resident appraisers. Appraisal of farm at market value. |
| If proposals for composition or extension accepted by majority of creditors, case dismissed. | If local or national emergency, moratorium granted with no time limit specified. For "unworthy" farmers, no relief. | Moratorium of three years with rental payments as approved by creditors. |
| If not accepted, section 75(a) can be applied: appraisal of farm and moratorium of three years with rental payments. | Payment of rentals. At two years, or one-year intervals, question of emergency may be raised by creditors in court hearings. Default in rentals must be cleared in 60 days. | During moratorium, debtor may propose extension of composition ("plan") to be accepted by all or majority of creditors and approved by court. |
| During, or at end of, moratorium, farmer can offer to pay appraisal value and own farm debt free, but prior reappraisal may be ordered. Sale through public auction with redemption, or other method, if farmer cannot refinance himself. | After the end of moratorium farmer may ask for extension of secured debts and composition for unsecured debts. Extension may modify payment plan and interests on secured debts. | As alternative, debtor may attempt redemption of farm at appraised (or reappraised value) through full payment. Or: |
| | If no extension plan is submitted, case dismissed or farmer goes through regular bankruptcy procedure. | If one-half of (re) appraised value was paid during moratorium, additional two years are granted to pay remainder. |

of its provisions, it is stated that a "national emergency" is a cause of a debtor's insolvency beyond his control for which he may be granted relief. Finally, by eliminating all major debt adjustments, the bill side-steps the problem of over-indebted farmers who deserve to have their financial structure readjusted.

Regular Bankruptcy and Frazier Lemke Cases Studied

A good law must be based on one or several well-defined objectives. It must contain provisions which are suited to implement the attainment of these objectives. It should take into account the experiences of the past.

The research for which this summary and preliminary report describes the basic problem area,

should be helpful in considering farmer-debtor relief legislation. It attempts first of all to study the heretofore neglected question of how the Frazier Lemke Act actually operated in South Dakota and other Plains states and its adequacy in providing relief; secondly, on the basis of past experience to single out the objectives that such a legislation can hope to achieve, and the methods that are most likely to bring it about.

A preliminary inquiry into farmer bankruptcy cases in the state has brought to light some specific problems.

(1) From 1928 to 1952, there were 792 farm bankruptcies, including regular and section 75 cases..

Continued on page 99

FEED ANALYSES

O. E. OLSON, WM. KOHLMAYER and L. B. EMBRY

FEED ANALYSES are used for a variety of purposes. One very important use is in the control of feed manufacturing, where certain standards must be met and where uniformity of product should be maintained. State feed regulatory agencies also make analyses to make certain that commercial feeds on the market meet certain specifications as set by law. Another very important user is the research worker, who makes analyses on feeds for numer-

ous purposes. Finally, the feeder, himself, often needs analyses made to assist him in the solution of nutritional or other livestock problems.

Feeds contain many nutrients that can be determined by chemical means, but because each determination is costly and time-consuming, under no circumstance are all analyses made on any single sample. Instead, only those which might be of definite value are made. The feed manufacturer and state regulatory

Laboratory technician weighing out samples for analyses



agencies have laws to guide them in deciding which nutrient the chemist should measure, and research workers have fairly well-established means for selecting what analyses should be made.

In the case of the farmer or rancher, however, there often is no simple set of rules to follow which will assure the wise use of chemical determinations. Instead, each case must be considered by itself. Only by exercising good judgement, based on a knowledge of the meaning and limitations of the many kinds of analyses, and on previous experience with them, can such wise use be assured. It is the purpose of this article to discuss the meaning and value for many types of feed analyses and to point out their limitations.

Meaning and Value of Various Analyses

The term "complete analysis" is often used in connection with feeds. It implies that feeds are analyzed for everything they contain, but such an analysis would be an unending task and is never undertaken. To the chemist the expression "complete analysis" means the same as proximate analysis, which consists of determining the amounts of moisture, crude protein, crude fibre, ether extract, ash and nitrogen-free extract in a feed. The proximate analysis is widely used in experimental, control and regulatory work.

The value of a feed analysis to the livestock producer is that it enables him to meet more accurately the nutritional needs of his livestock than he can by merely using average

composition of feed stuffs given in various books on livestock feeding. Feeds vary widely in their content of some nutrients, and average values may have little meaning when applied to one particular lot of feed. However, the need for making a "complete" or proximate analysis for general feeding purposes seldom arises. On the other hand, some parts of this analysis are very helpful on occasion, as discussed below.

Moisture: All feeds contain some moisture. From a nutrient standpoint, it is an unimportant component of the feed. A moisture analysis is usually not necessary when feeding low moisture feeds (feeds that can be stored safely), but since all the feed nutrients are contained in the dry matter, the moisture content is an important consideration when purchasing or feeding high moisture feeds.

Crude Protein: Protein is used by the animal for building muscle tissues, cartilage, connective tissues, skin, hair, wool, feathers, horns and internal organs. It is, therefore, one of the most important constituents of feeds from the standpoint of nutrition. The method used routinely for its analysis measures some non-protein materials as protein. Normally the error caused by this is insignificant from the standpoint of feeding, but in view of it the term "crude protein" is usually used in expressing the results of an analysis.

Considering the several determinations a proximate analysis includes, crude protein is generally the most valuable one. The protein content of many feeds varies widely.

It is usually the most expensive portion of the ration and is often deficient in farm grown grains and roughages. Thus, the greatest outlay of cash for purchased feeds by most livestock feeders will be for protein supplements. When the protein content of the major feeds available on the farm is known, they can often be used in various combinations to meet a large part or all of the protein needs of cattle and sheep. In the case of swine self-fed a protein supplement along with grain, no advantage could be made of a protein analysis on the grain. However, when complete rations are mixed for swine and poultry, protein content of the ingredients going into the mixture is needed in order to know how much protein supplement to add. The crude protein determination tells nothing of the nutritive value of the protein, an important consideration in swine and poultry rations.

The rations of cattle and sheep consist largely of roughages except when they are fed under feed-lot conditions. It is important that these rations contain an adequate amount of protein. The crude protein content of the roughages will vary widely, and it appears to be the best single measure of the nutritive value of these feeds.

Ether Extract: One of the sources of energy in a feed is its fat. The analyst measures this by extracting the sample with ether. This method of removing the fat also removes oils and certain other substances, so the term "fat" when applied to this measurement is not entirely correct.

The term "crude fat" is sometimes used instead of ether extract.

The ether extract in feeds is a high energy nutrient. However, most feeds are rather low in their content of this material and a special analysis for it is not often warranted.

Ash: The ash content of a feed is determined by burning off the organic matter and weighing the residue. Ash is composed of minerals, but the results of an ash determination tell little of the nutritive value of this fraction since they do not indicate the amounts of the various minerals present.

Crude Fiber: The chemical method for measuring the fibrous material in feeds is subject to errors, and the term "crude fiber" is therefore used in reference to its analysis. Crude fiber is rather resistant to digestion and has little value for poultry and swine, but cattle and sheep make some use of it. This fraction is carbohydrate in nature, and the animals that do digest it to some extent derive some energy from it. An analysis for crude fiber is seldom of much value to the feeder, since swine and poultry rations are normally composed of low fiber content feeds (grains), the high fiber content feeds (forages) being used for cattle and sheep.

Nitrogen-free Extract: Nitrogen-free extract is often expressed in abbreviated form as NFE. It is composed largely of carbohydrates (sugars and starches and similar substances) and is the major source of energy in feeds. The value for nitrogen-free extract is determined by subtracting the percentages of

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Soil Survey-SPINK COUNTY



Photo courtesy of Roy W. Simonson

Small grain and corn on La Delle silt loam in Spink County

By F. C. WESTIN

A SOIL SURVEY of Spink County has been completed by the Agricultural Experiment Station and the Soil Conservation Service, USDA, and will soon be published. For farmers and others interested in specific tracts of land, this soil survey is meant to answer three main questions: (1) What crops will grow best on my farm? (2) What treatment does my soil need to make it yield its best? and, (3) What yields can I expect?

For readers interested in the area as a whole, this soil survey discusses the location and extent of Spink County, its physiography, relief, drainage, climate, present status of agriculture, organization and population, and transportation facilities.

The irrigation potential of each soil mapped in the county is also indicated.

Brief summary of Soil Survey Report

Spink County covers an area of 936,840 acres in east central South Dakota. The topography is nearly level to undulating with only a few rolling areas. Elevations above sea level range from about 1300 to 1400 feet. Drainage is to the south with the principal stream being the James River.

The native vegetation consists of a mixture of short, mid, and tall grasses. In general, the undulating uplands have mixtures of short and mid grasses, while the sandy plain and the alluvial areas are occupied by the tall and mid grasses.

The materials from which the soils have developed include glacial deposits of sand, silt, clay, and gravel; and alluvium (stream deposits).

The soils are classified according to their internal and external characteristics, with emphasis on the features that influence crop production. Productivity of a particular soil depends on a large number of factors which include climate, soil characteristics and management. Of these, management is the only factor that can be controlled. A system of management consists of several

control practices are used in a good management system.

19 Soil Groups

The soils of the county have been divided into 19 groups on the basis of the factors which affect the use and management of the soil. The principal problems of management for each of the 19 groups of soils are discussed, and estimated yields of wheat, corn, oats, barley, alfalfa and wild hay are given for each soil. (Project 183. Leaders: F. C. Westin, G. J. Buntley, F. E. Shubeck, A. J. Klingelhoets, Agronomy Dept., in cooperation with Soil Conservation Service, USDA.)

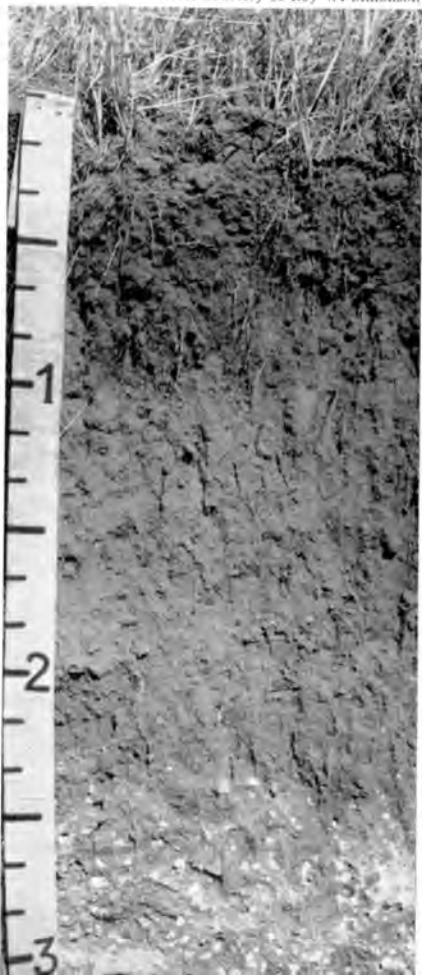


The soil surveyor maps soil differences as they occur naturally out in the field

practices, which the farmer selects and combines into the system best suited to his farm. Since the soil pattern differs for each farm, it therefore influences the choice of management practices. Crop rotations, maintenance of organic matter in the soil, tillage, the use of commercial fertilizers and erosion

Profile of Beadle silt loam, one of the fertile soils in south central Spink Co.

Photo courtesy of Roy W. Simonson



BREED, DIET SEX

Affect the

Growth Response

of Chicks to

ANTIBIOTICS

By C. W. CARLSON

ALL CHICKS will not respond alike to antibiotics. Numerous reports have appeared concerning the differences in the antibiotic growth response that were obtained from different types of chickens. In some cases, these variations occurred with different strains of the same breed. It has been found in studies conducted at this station over the past several years that a great number of factors must be involved in this phenomena.

No one can yet adequately explain why the antibiotics produce this effect of improving the rate of growth of chickens, turkeys, and other animals. Chicks or turkeys normally contain literally millions of bacteria, and it would be expected that something which would affect the bacteria might indirectly affect the bird. It is believed that the antibiotics inhibit the growth of undesirable bacteria and promote the

growth of desirable bacteria in the digestive tract. The undesirable bacteria would be those that produce toxins that might adversely affect the bird's ability to digest and absorb feed nutrients, thus slowing up the growth rate, whereas the desirable bacteria may actually produce vitamins that the bird can utilize for its own needs. A significant report indicated that chicks which were raised under sterile conditions, or free of bacteria, did not show any growth response to the antibiotics. Other reports have indicated no responses when chicks were reared in new quarters or where exhaustive sanitary measures were taken.

In the studies reported here, all chicks were raised to four weeks of age in electrically heated batteries with raised wire floors. Chicks used during the successive years were from the same strains, but of later generations. Some improved growth rates may have been the result of the selection and mating methods.





Less Growth Response to Antibiotics with Better Diets

The diets used were formulated to be adequate in all known nutrients required for growth. The medium energy diet consisted of a variety of the commonly used ingredients, including animal protein supplements. The corn-soybean diets would be considered the high energy and high efficiency types. Some changes in the original diet used in the summer of 1952 were made in successive seasons, which in part effected an improved rate of growth. Particularly effective was the change made from winter to spring in 1954.

Although the data are not given here, small but consistent growth responses were obtained on the corn-soybean type diets from animal protein supplements or a commercially prepared fermentation material. In general, the growth responses to antibiotics would be ex-

pected to be less on such supplemented diets. Wider variations could be expected by using unsupplemented diets, and the data reported in Table 2 are results obtained with their use.

For the most part, procaine penicillin was the sole antibiotic used and at levels of from 2 to 15 grams per ton. Many workers have found that a level of 2 grams per ton is adequate for the maximum growth response. Early work at this station had indicated no beneficial effect from the combination of other antibiotics with penicillin. Since other workers had reported more consistent effects with combinations of antibiotics, the use of terramycin along with penicillin was employed when it appeared that the growth responses were decreasing.

The results of the growth trials are given in Tables 1 and 2. A wide variation in growth responses to the antibiotics is evident. The responses range from a maximum of 49

Table 1. Growth Response to Penicillin Supplementation with Various Types of Chicks on a Medium Energy Diet

| Type of Chick | Unsupplemented Growth Weight (4 Weeks) | | Increase with Penicillin Supplementation | |
|------------------------|---|-----------|---|---------|
| | Winter 1951 | | | |
| | Males | Females | Males | Females |
| | gm. | gm. | % | % |
| W. P. Rock | 195 (22) * | 195 (31) | 49 (51) | 31 (51) |
| S. C. W. Leghorn | 242 (13) | 236 (7) | 31 (11) | 17 (9) |
| N. Hampshire | 285 (34) | 253 (25) | 18 (86) | 16 (67) |
| B. P. Rock X R. I. Red | 288 (8) | 256 (13) | 11 (10) | 14 (13) |
| Northwester | 367 (10) | 327 (16) | 9 (14) | 14 (11) |
| | Spring 1951 | | | |
| | Mixed Sex | Mixed Sex | | |
| | gm. | % | | |
| S. C. B. Leghorn | 168 (21) | 9 (20) | | |
| B. Orpington | 198 (9) | 14 (8) | | |
| B. Andalusian | 205 (27) | 15 (29) | | |
| L. Brahma | 220 (14) | 18 (14) | | |
| D. Cornish | 238 (39) | 25 (39) | | |

*Numbers in parentheses refer to the number of surviving chicks.

percent for White Plymouth Rock males on the medium energy diet in the winter of '51 to zero for New Hampshire and Single Cross No. 2 X White Plymouth Rock females on the corn-soybean type diets in the summers of '52 and '53.

It is obvious that all of the facts are not given in these two tables. Different environmental conditions were certainly encountered. The degree of "normal infection" no doubt varied from trial to trial. To have known what types and numbers of bacteria were present in the digestive tracts of the chicks in the various trials might well have allowed for explanation of some of the variations in results. Where there are comparisons available between seasons of the same year and with similar diets, *i.e.* winter and spring of '51 and '54, the general trend indicates a greater response in the winter. This might indicate a greater degree of "normal infection" in the winter, however, such possible variations

could not have explained all of the differences encountered.

Response Varies Between Sexes

Where results for both sexes are given, the data represent the average of each sex from a group of straight-run or mixed-sex chicks placed in the pen at the start of the growth trial. Therefore, the two sexes should have been exposed to the same "normal infection." As can be seen from the data, the relative responses shown by males do not correspond in all cases to the relative responses shown by the females. In all cases, the male chicks did respond, whereas in three instances the female chicks—New Hampshires of the summers of '52 and '53 and the single cross No. 2 X White Plymouth Rocks (this single cross contained New Hampshire breeding)—did not respond to the addition of penicillin to the corn-soybean type diets. It is interesting to note that the female White Plymouth Rock X New

Hampshire chicks responded to penicillin supplementation. Further, where terramycin was also added to the corn-soybean diets, the new Hampshire females did respond. It appeared, therefore, that the "normal infection" did not similarly affect the sexes.

That there are breed differences is substantiated by the results obtained in the winter of '51 which indicated that in cases where the unsupplemented growth rate was greater, the growth response obtainable from penicillin was less. However, with the less common breeds in the spring of '51, just the reverse trend was noted. In most other instances where the unsupplemented growth rate was made greater, (either due to the crossing of breeds as in the summer of '53 or

to the dietary and possible environmental differences between the winter and spring of '54) the responses to the antibiotics were less.

It would be logical to assume, therefore, that where the growth rate approaches the maximum, supplementation with antibiotics would be less effective. Such things as the use of certain cross-breeds or strains selected for a faster growth rate, the use of improved diets, or greater care in management may all contribute to the reduction of growth responses from the antibiotics. However, even under the best of field conditions the antibiotics can be expected to improve significantly the growth rate of chicks. (Project 241. Leaders: C. W. Carlson and R. A. Wilcox, Poultry Dept., O. E. Olson, Station Biochemistry.)

Table 2. Growth Response to Antibiotic Supplementation with Various Types of Chicks on Corn-Soybean Type Diets

| Type of Chick | Unsupplemented Growth Weight (4 Weeks) | | Increase with Antibiotic Supplementation | |
|---|--|---------|--|---------|
| | Males | Females | Males | Females |
| | gm. | gm. | % | % |
| Summer 1952—Penicillin—2gm./ton | | | | |
| W. P. Rock | 232(28)* | 203(38) | 11(36) | 10(32) |
| N. Hampshire | 242(17) | 231(16) | 7(19) | -1(14) |
| Summer 1953—Penicillin—4 gm./ton | | | | |
| N. Hampshire | 230(13) | 235(14) | 14(14) | 0(14) |
| B. P. Rock | 267(26) | 242(17) | 5(18) | 16(24) |
| W. P. Rock | 273(8) | 220(8) | 15(8) | 19(7) |
| S. C. No. 1 X W. P. Rock | 273(26) | 241(22) | 5(26) | 16(28) |
| W. P. Rock X N. Hampshire | 282(66) | 265(58) | 11(66) | 8(59) |
| S. C. No. 2 X W. P. Rock | 322(29) | 309(30) | 8(27) | -1(33) |
| Winter 1954—Penicillin and Terramycin—4 and 10 gm./ton | | | | |
| N. Hampshire | 264(36) | 246(41) | 14(37) | 9(44) |
| W. P. Rock | 279(65) | 261(78) | 21(65) | 14(78) |
| Exp. Hybrid | 288(16) | 256(18) | 5(19) | 8(17) |
| Spring 1954—Penicillin and Terramycin—12 and 30 gm./ton | | | | |
| S. C. W. Leghorn | 254(42) | | 7(43) | |
| N. Hampshire | 287(43) | 250(42) | 5(46) | 8(36) |
| W. P. Rock | 318(50) | 303(50) | 11(49) | 6(53) |

*Numbers in parentheses refer to numbers of surviving chicks.

moisture, protein, ether extract, crude fiber and ash from 100 percent, so its determination obviously involves the analysis for all of these components.

Grains are the chief sources of this high energy nutrient and are not supplemented with other high energy ingredients as they are with high protein ingredients, except for some special type of commercial feeds. When a ration composed largely of roughages does not produce the desired weight gains, grain should probably be substituted for a part of the roughage. An analysis for nitrogen-free extract made on the roughage may be of some assistance in determining the need for such grain supplementation. There are other instances where this analysis may be helpful, but these are not nearly as frequent as where the crude protein analysis is of value.

Minerals

The animal body requires many mineral elements for growth. Some are required in fairly large amounts (principal minerals) while others are required in very small amounts (trace materials). (See *Farm and Home Research*, Volume III, No. 3, page 59, 1952).

Present day feeding practices prescribe the supplementation of rations with calcium, phosphorus and salt, and the remaining principal minerals are generally present in feeds in sufficient quantities. Iodine and cobalt are the only trace minerals that are of concern. The logical and safe way of supplying these two

mineral elements is by the use of salt containing iodine and cobalt. For poultry, manganese may be deficient in feeds, and it is commonly added as a supplement to the ration.

The usual practice and recommendation in supplying minerals to livestock is to provide mineral supplements free choice. Such a procedure appears to meet adequately the needs of livestock. When this practice is followed, there is very little need for analyzing for the individual minerals in a feed intended for use in a general feeding program. Analysis of feeds may be needed when nutritional deficiencies are suspected in animals that are fed rations normally considered adequate. In such cases, a livestock nutritionist or veterinarian should be consulted before submitting samples to the laboratory.

Vitamins

Vitamin A: Carotene is the form in which vitamin A occurs in plant materials. The green plant materials are good sources of carotene, and the amount of green color in hays is a good index of carotene content, because chlorophyll and carotene are destroyed at about the same rate in the hay making and storage process. Good quality hays (with green color) and silages stored under proper conditions are excellent sources of carotene, and yellow corn is a fairly good source. Carotene as such has no vitamin A activity, but it is converted to vitamin A in the animal body.

Vitamin A, itself, is often added to mixed feeds. Both carotene and

vitamin A may be destroyed in these mixtures (the form in which they are added and the composition of the feed affects the stability), and after periods of storage the content of either may be markedly reduced. Normally, knowing the types of feed that are being used makes it possible to determine whether sufficient vitamin A or carotene is being supplied. In some cases, however, analysis of the feed is necessary. With hays and grains, or with silages, carotene is determined, while with mixed feeds it may be necessary to determine vitamin A itself. This should be kept in mind in sending samples of mixed feeds for analysis.

Other Vitamins: Except for carotene and vitamin A, feeds are seldom analyzed for vitamin content unless experimental, regulatory or control work is concerned. Most vitamin assays are difficult and expensive. Furthermore, the approximate vitamin contents for most common feed-stuffs are known accurately enough to estimate the amounts a ration is supplying with greater accuracy than we now know vitamin requirements.

Poisons and Molds

Poisons and molds in feeds have been discussed in a previous issue of *Farm and Home Research* (Volume V, No. 3, page 56, 1954) and the reader is referred to this discussion for many details in connection with the examination of feeds for the presence of these.

Digestibility of Nutrients

Requests are often received for the analysis of hog, sheep, or cattle feeds for digestible nutrient con-

tent. The "complete" or proximate analysis tells nothing of the digestibility of the various nutrients. This must be determined by actual digestion trials of rather long duration with large animals. Obviously, this determination cannot be made routinely. However, values for percent digestibility of protein and other nutrients (digestion coefficients) have been determined for most common feeds and are recorded in several books on nutrition (for example, *Feeds and Feeding* by F. B. Morrison, Morrison Publishing Co., Ithaca, N. Y.). Using these values and knowing the chemical composition of a feed, we can calculate the approximate amount of digestible protein and TDN (total digestible nutrients) in the feed. This calculation can be made at the laboratory when requested, provided the kind of animal being fed is known and provided the digestion coefficient for the particular feed is known. The digestion coefficients are not available for mixed feeds, grain screenings and similar materials that vary considerably in composition.

Sometimes requests are received for determinations of "feeding value" or for the money value of a feed. The term "feeding value" is a rather vague expression, and there is no chemical determination that will measure it nor any quantitative way to express it. "Feeding value" includes many factors such as palatability, nutrient and vitamin content, digestibility and others. The proximate analysis may give some indication of "feeding value," but only through feeding trials can it be accurately measured.

Since supply and demand and

many other factors are important in regulating price, it is impossible to calculate accurately the worth of a feed in terms of dollars and cents. Occasionally, however, some help can be obtained in assessing the comparative value of two feeds by protein or other analyses.

Commercial Feeds

Commerically prepared feeds or feed concentrates usually bear a label on which is stated a guaranteed analysis and a list of ingredients. Hence analytical work is unnecessary, except as a regulatory measure. With feed mixtures for which no guaranteed analysis or list of ingredients is given, a limited chemical analysis may be of some value. However, analyses for trace minerals, antibiotics, arsenicals or vitamins (with the possible exception of carotene or vitamin A) are not made on these mixtures at this laboratory because the information obtained from these analyses seldom if ever justifies the cost. As concerns ingredients (percent corn, soybean oil meal screenings, etc.), an accurate analysis is not possible.

Sampling Feeds

The chemist can analyze only what is sent him, and unless the sample he receives is representative of the entire stack, bin, field, crib or sack, the results he obtains will be of little value. Picking an ear or two of corn from a crib, a handful of hay from a stack, or a handful of feed from the top of a sack is poor sampling procedure. In sampling any feedstuff, every effort should be made to obtain material from a num-

ber of points throughout the supply. The material thus obtained may be too large for shipment, so mixing of the combined samples and resampling from this mixture may be necessary.

The amount of sample to collect will depend upon the situation. Generally, only small amounts are necessary for analysis, but in order to insure that a representative sample is obtained, far more is taken than is required by the chemist. When in doubt, send at least two pounds.

Shipment of Samples

Samples should always be carefully wrapped and clearly and properly addressed as follows: Station Biochemistry, College Station, South Dakota. The return address should always be used, since some means of identification of the sample is necessary. Moist samples, such as silage, should be sent in air tight containers to prevent moisture loss. Finally, a letter or post card should be sent describing the sample and explaining what analysis is wanted, or describing in detail why an analysis is requested so that the chemist can decide what should be done.

Questions may arise concerning feed analysis that are not answered here. If the County Agricultural Agent does not have the answer, an inquiry can be directed to this laboratory. Charges are made for most feed analyses, and the county agricultural agent has a list of these charges. (Project 120, Leaders: L. B. Embry, Animal Husbandry; and O. E. Olson, Station Biochemistry).



Sorghum

FOR GROWING-FATTENING PIGS

R. F. WILSON

NUMEROUS INQUIRIES have been received by the Station concerning the feeding value of Norghum. Norghum, an early grain sorghum, adapted to South Dakota growing conditions, was released by the South Dakota Experiment Station in 1949, and has since been grown rather extensively.

To answer these inquiries the Station at Brookings made a comparison of yellow corn with Norghum, both ground and whole, for growing-fattening pigs fed in dry lot. Two trials were conducted; one in the winter of 1949-50 and one in the winter of 1950-51. Experimental work with grain sorghums at other stations indicate that most varieties have a feeding value of approximately 90 percent as much as shelled corn, and nearly all varieties tested to date have been found deficient in carotene (vitamin A).

How the Feeding Trial Was Conducted

Weanling pigs, were allotted in each of the trials on the basis of sex, age, weight and litter to give as nearly as possible, comparable lots of pigs. Pigs of the Duroc, Poland

China and Spotted Poland China breeds were used in these trials.

In each trial, three lots of pigs were self-fed, free choice, a grain (corn or Norghum), a protein supplement, and a mineral mixture. In the first trial the protein supplement consisted of 2 parts tankage, 1 part soybean meal and 1 part of dehydrated alfalfa with 1 pound of vitamin A and D added for each 400 pounds of protein supplement. The mineral mixture consisted of 2 parts steamed bonemeal, 2 parts ground limestone and 1 part iodized salt.

In the second trial, the protein supplement consisted of 42 parts tankage, 27 parts soybean meal, 26 parts ground sun-cured alfalfa hay and 5 parts of a complex mineral mixture.

The mineral mixture fed in the second trial was the same as that fed in the first trial except that a trace mineral mixture was added to the iodized salt. This mineral mixture was added to the protein supplement in the second trial as well as self-fed free choice.

Test weights of the grains fed in the first trial were: shelled corn, 53.5

pounds per bushel, and Norghum, 54 pounds per bushel. Test weights of the grains in the second trial were, shelled corn, 53 pounds per bushel, and Norghum, 51 pounds per bushel with 1 percent dockage. It was necessary to clean the Norghum before feeding in the second trial because of weed seeds and trash. Chemical analysis of the grains fed are shown in Table 1.

Pigs Make Good Gains on Whole Norghum

Results of the first trial are given in Table 2 and those of the second trial in Table 3. It will be noted, from Table 2, that the greatest daily gain was made by the pigs that received the Norghum, both ground and whole. Feed consumption per pig was also higher for those fed Norghum, with the largest amount being eaten by those fed the whole sorghum. The feed required per hundred pounds of gain was nearly the same for the three lots. The sorghum-fed pigs consumed slightly more protein supplement per hundred pounds of gain even though the Norghum contained more protein than did shelled corn. On the basis of total feed required per hundred pounds of gain, the ground Norghum had 98.5 percent

of the feeding value of the corn, while the whole Norghum had a feeding value of 98.6 percent.

Considerably less feed cost per hundred pounds of gain resulted in the shelled corn lot than in either of the Norghum lots. This, of course, was due to the fact that Norghum cost considerably more per pound than the corn. During the fall and winter of 1949-50, Norghum was rather difficult to obtain; consequently, the price was relatively high.

In the second trial (Table 3) the pigs in all lots made less average daily gains than did the pigs in the first trial. In this trial, the gain made by the whole-Norghum-fed pigs was only slightly greater than that of the corn-fed pigs, while the pigs fed ground Norghum made the least gain. In feed consumed daily per pig, there was a greater consumption of both ground and whole Norghum than shelled corn.

In feed required per hundred pounds of gain, the shelled corn lot was the most efficient, followed by the whole-Norghum lot and lastly by the ground-Norghum lot. Feed costs per hundred pounds of gain were again dependent upon the prices paid for the grains. However, during this fall and winter, sorghum was somewhat of a better

Table 1. Chemical Composition of Grains Fed

| | Moisture | Ether Extract (Crude Fat) | Crude Fiber | Crude Protein | Ash (Mineral) | Nitrogen- Free Extract |
|--------------------------------------|----------|------------------------------|----------------|------------------|------------------|---------------------------|
| First Trial (winter 1949-50) | | | | | | |
| Shelled yellow corn | 14.70 | 3.90 | 1.78 | 9.04 | 1.32 | 69.26 |
| Norghum sorghum | 12.83 | 2.91 | 1.76 | 11.28 | 1.55 | 69.67 |
| Second Trial (winter 1950-51) | | | | | | |
| Shelled yellow corn | 12.10 | 4.02 | 1.83 | 9.09 | 1.11 | 71.85 |
| Norghum sorghum | 13.18 | 3.15 | 1.71 | 11.12 | 1.54 | 69.30 |

Table 2. Norghum Sorghum Compared to Shelled Yellow Corn for Growing-Fattening Pigs, 1949-50

| Items Compared | Lot I Shelled Yellow Corn | Lot II Ground Nor- ghum Sorghum | Lot III Whole Nor- ghum Sorghum |
|---|---------------------------------|---------------------------------------|---------------------------------------|
| Number of pigs | 10 | 10 | 10 |
| Average days on test | 103.0 | 99.0 | 95.5 |
| Average initial weight, lbs. | 55.2 | 55.8 | 56.1 |
| Average final weight, lbs. | 224.4 | 224.9 | 224.4 |
| Average total gain, lbs. | 169.2 | 169.1 | 168.3 |
| Average daily gain, lbs. | 1.64 | 1.71 | 1.76 |
| Average daily feed consumed per pig, lbs. | | | |
| Grain | 5.81 | 6.11 | 6.25 |
| Protein supplement | 0.70 | 0.78 | 0.86 |
| Mineral | 0.06 | 0.06 | 0.05 |
| Feed | 6.57 | 6.95 | 7.16 |
| Feed consumed per 100 lbs. of gain, lbs. | | | |
| Shelled corn | 354.3 | | |
| Norghum sorghum (ground) | | 357.5 | |
| Norghum sorghum (whole) | | | 354.7 |
| Protein supplement | 43.0 | 45.8 | 49.1 |
| Mineral mixture | 3.7 | 3.7 | 2.7 |
| Total | 401.0 | 407.0 | 406.5 |
| Feed cost per cwt. gain* | \$9.15 | \$12.49 | \$11.89 |

*Feed prices used: shelled corn, \$1.16 per bu.; Norghum sorghum (whole), \$2.65 per cwt.; Norghum sorghum (ground), \$2.70 per cwt.; tankage, \$5.75 per cwt.; soybean meal, \$4.40 per cwt.; dehydrated alfalfa meal, \$3.70 per cwt.; vitamin A and D oil, \$.25 per pound; ground feeding limestone, \$.70 per cwt.; steamed bonemeal, \$4.25 per cwt.; iodized salt, \$1.35 per cwt.

buy than shelled yellow corn and consequently the whole-Norghum-fed lot had a lower feed cost per hundred pounds of gain than the shelled-corn lot. This was not true of the ground-Norghum lot, however.

These trials indicate that Norghum is quite comparable in feeding value to other grain sorghums. In the first trial, both ground and whole Norghum had, on the basis of total feed required per hundred pounds of gain, an approximate feeding value of 98 percent of that of shelled yellow corn, but in the second trial on the same basis, the whole Norghum had a value of

about 91 percent and the ground Norghum, a value of 76 percent.

Tightly Constructed Feeder Needed

Some difficulty was encountered with the feeding of Norghum sorghum, particularly with the whole Norghum. Since the kernels are round and rather smooth, Norghum has a tendency to run down in the feeder and fill the feeding cups. It also has a tendency to run out of the feeder if the feeder is not exceptionally tight. Consequently, whole Norghum must be self-fed in a tightly constructed feeder, otherwise considerable waste may result, especial-

Table 3. Norghum Sorghum Compared to Shelled Yellow Corn for Growing-Fattening Pigs, 1950-51

| Items Compared | Lot I Shelled Yellow Corn | Lot II Ground Nor- ghum Sorghum | Lot III Whole Nor- ghum Sorghum |
|---|---------------------------------|---------------------------------------|---------------------------------------|
| Number of pigs | 10 | 10 | 10 |
| Average number days on test | 128.8 | 132.8 | 128.1 |
| Average initial weight, lbs. | 43.2 | 43.1 | 42.8 |
| Average final weight, lbs. | 223.0 | 221.7 | 223.3 |
| Average total gain, lbs. | 179.8 | 178.6 | 180.5 |
| Average daily gain, lbs. | 1.40 | 1.45 | 1.41 |
| Average daily feed consumed per pig, lbs. | | | |
| Grain | 4.84 | 6.44 | 5.58 |
| Protein supplement | 0.60 | 0.49 | 0.47 |
| Mineral | 0.01 | 0.01 | 0.01 |
| Feed | 5.45 | 6.94 | 6.06 |
| Feed consumed per cwt. of gain, lbs. | | | |
| Shelled corn | 346.7 | | |
| Norghum sorghum (ground) | | 476.8 | |
| Norghum sorghum (whole) | | | 396.1 |
| Protein supplement | 42.8 | 36.2 | 33.2 |
| Mineral mixture | 0.8 | 0.9 | 0.9 |
| Total feed | 390.3 | 513.9 | 430.2 |
| Feed cost per cwt. of gain* | \$11.03 | \$12.20 | \$10.06 |

*Feed prices used: shelled corn, \$1.50 per bu.; Norghum sorghum (whole), \$2.20 per cwt.; Norghum sorghum (ground), \$2.25 per cwt.; tannage, \$5.50 per cwt.; soybean meal, \$4.25 per cwt.; alfalfa hay \$30.00 per ton; ground feeding limestone, \$1.30 per cwt.; bonemeal, \$5.25 per cwt.; iodized salt plus trace mineral mixture, \$2.20 per cwt.

ly when the feeding is done outside during the winter.

It did not pay to grind the Norghum in either trial, as the pigs fed the whole Norghum made slightly more gain on less feed and at less cost. In the whole-Norghum lot a considerable number of the whole sorghum kernels passed through the pigs without being completely broken down in the digestive process. However, even though this took place, the whole-Norghum lots in both trials required less feed per hundred pounds of gain than the ground-Norghum lots.

Summary

The results of two years' trials comparing ground and whole Norghum sorghum with shelled corn indicate that Norghum sorghum has a feeding value approximately the same as other grain sorghums. The feeding value is about 90 percent that of corn. These trials show that whole sorghum was a more efficient feed than ground sorghum, but that either ground or whole sorghum must be fed from tightly constructed feeders to prevent excessive waste. (Project 85. Leader: R. F. Wilson, former Associate Animal Husbandman, Animal Husbandry Dept.)

Farmer-Debtor Relief Legislation Continued from page 82

This number is slightly below the 942 non-farm bankruptcies. After 1928, the number of farm cases declined, but it rose strongly in 1934 and 1935, and again in 1938, because of the relatively large number of s. 75 cases. Interestingly enough, farmers continued to go through *regular* bankruptcy procedure throughout the thirties and forties (Fig. 1) even though s. 75 gave them a form of relief not provided for by regular bankruptcy. The reason for this is not yet clear. It has been suggested that regular bankruptcy permits a farmer to make a "clean break with his past," while s. 75 would assume that the farmer wishes to continue his farming operation. In many instances, farmers may have been too discouraged to continue to farm. A detailed study may furnish the answer.

(2) The number of *regular* farm bankruptcy cases followed the general pattern of the non-farm bankruptcies, as shown in Fig. 1. This suggests that s. 75 did hold a promise for farmers that a regular procedure did not hold. It is noteworthy that the worsening of economic condi-

tions since 1929 was accompanied in South Dakota by a declining trend in the number of bankruptcy cases.

(3) The total number of cases has been largest in some of the best farming counties where farming is relatively diversified and where the effects of the drought may have been less severe than in other parts of the state. The largest number of cases, both regular and s. 75 cases, was in the southeastern corner of the state.

(4) The number of s. 75 cases was usually higher in those areas where regular cases were high. This suggests that the criticism that farmers took "undue advantage" of the legislation may not be justified. However, there were wide areas in South Dakota in which only a few bankruptcies were recorded during the 25-year period.

(5) Foreclosures seem to reflect more closely the amount of risk in farming than bankruptcies (Table 2). Few counties had less than 200, several had more than 1,000 foreclosures from 1928 to 1949. Foreclosures were heaviest in the western part of the state. Closer analysis

Table 2. Foreclosures (1928-49) and Bankruptcies (1928-53) in South Dakota

| Economic Area | Number of Farms in 1950 | Foreclosures (1928-49)* | | Bankruptcies (1928-53) | |
|---------------|-------------------------|-------------------------|-----------------------|--------------------------------|-----------------------|
| | | Total Number | Number Per 1000 Farms | Total Number and (s. 75 Cases) | Number Per 1000 Farms |
| 1 ——— | 11,047 | 7,475 | 680 | 81 (10) | 7.3 |
| 2a ——— | 7,169 | 4,208 | 590 | 54 (10) | 7.5 |
| 2b ——— | 9,514 | 5,518 | 580 | 166 (87) | 17.4 |
| 3a ——— | 4,869 | 3,254 | 670 | 41 (6) | 8.4 |
| 3b ——— | 10,572 | 4,384 | 410 | 135 (21) | 12.8 |
| 4a ——— | 10,377 | 4,371 | 420 | 90 (20) | 8.7 |
| 4b ——— | 12,783 | 3,125 | 240 | 226 (95) | 17.7 |

*Source: Farm Mortgage Foreclosures in South Dakota 1921-1949, Gabriel Lundy and Ray F. Pengra, Rev. Supplement to Circular 17, Agricultural Economics Department, South Dakota State College, December 1950.

may reveal the peculiar circumstances under which farmers resort to bankruptcy procedures. The small number of 8.75 cases in relation to the incidence of foreclosures undoubtedly makes an examination of the adequacy of the legislation in giving relief to distressed farmers necessary.

(6) Of the 249 Frazier Lemke cases in South Dakota, 22 resulted in "discharge," 227 in "dismissal." Under the Act, a discharge was granted by the Court after completion of the redemption procedure. Apparently only a small proportion of farmers thus actually redeemed their farm as provided for by the Act. The reasons for the frequent "dismissals" are not yet clear. A dismissal could be ordered under the law, for example, if a farmer had reached an agreement with his creditors; or if he did not apply for confirmation of an extension or composition agreement. A failure to apply does not necessarily indicate that the Act failed to produce the desired effect, since a settlement with the creditors can always be reached outside of court.

Sometimes the fact that foreclosure procedures had already been completed before the farmer applied for relief; or the apparent lack of probability that the farmer would rehabilitate himself, were early grounds for dismissal until amendments to the law or court decisions

clarified the issues. There is reason to believe that during the first years the number of dismissals was larger than later. In any event, the frequent dismissals may have been a contributing factor in discouraging farmers from seeking benefits of the Act.

Relation to Farm Credit

The problem of relief legislation for farmers is closely connected with agricultural credit. On one hand, large credit institutions have recently maintained that a law such as the Frazier Lemke Act will "dry up credit" while simple moratorium legislation would not have this effect. While the issues are of course more complicated than would appear



from this argument, legislation such as the expired Act, does involve a greater recognition of the sharing of the farm risks by lenders. On the other hand, legislation which would include a redemption by the farmer apparently needs to be supplemented by provisions insuring adequate credit from private or public sources. (Project 240. Leader: E. Feder, Agricultural Economics Dept.)

CORRECTION

There was an error in the Spring Quarterly in the "Fly Control on the Farm" article. On page 54, Table 2, chlordane somehow got into the treatment for dairy buildings. Chlordane should not be used in dairy buildings. We are sorry this mistake was printed.

Annual Report

supplementing the quarterly reports

of the

South Dakota Farm and Home Research

for the year ending

June 30, 1954

MAJOR PROJECTS in research for many of the departments have been reported on in the forepart of this Annual Report. They will be listed here under the proper subject and a page reference given so the entire accomplishments of the Station in any one field will be apparent under a single heading.

Crops and Soils

Soil Fertility Treatments Increase Crop Yields

One of the most prevalent and important reasons for low crop yields is low fertility or the lack of sufficient plant food to nourish the crop. The fertility of the soil is influenced by soil management practices which include cropping systems, amount of manure and crop residues returned to the soil, and the use of fertilizer. Other factors which have an indirect influence on soil fertility are tillage practices and organic matter which affects soil structure and tilth. The effect of cropping systems on depletion of soil nitrogen and organic matter is shown in figure on page 102.

It is evident that crop production removes large quantities of nitrogen from soils and this element must be returned. Low crop yields due to lack of nitrogen are now very common. On the outlying soil fertility plots, nitrogen or nitrogen and phosphorus together had a pronounced effect on the yield of oats in

1953. Some of the results are presented in Table 1.

The effect of fertility treatments on the yield of oats at the South Dakota Agricultural Experiment Station is presented in Table 2.

The results of the soil fertility trials on oats in 1953 show that profitable yields

Table 1. The Effect of Nitrogen and Phosphorus Fertilizer on the Yield of Oats in South Dakota 1953

| Treatment Lbs./acre* | Lincoln County Bu/A | Clay County Bu/A | Lake County Bu/A | Davidson County Bu/A | Charles Mix County Bu/A |
|-------------------------|---------------------------|------------------------|------------------------|----------------------------|----------------------------------|
| 0-0-0 | 20.1 | 19.4 | 22.0 | 36.2 | 30.5 |
| 0-40-0 | 22.4 | 18.8 | 33.6 | 33.5 | 26.1 |
| 20-40-0 | 37.4 | 27.8 | 38.3 | 43.6 | 45.1 |
| 40-40-0 | 51.1 | 53.8 | 35.7 | 51.3 | 53.8 |
| 60-40-0 | 48.9 | 49.8 | 62.0 | 64.3 | 51.5 |
| 40-20-0 | 49.0 | 49.9 | 53.2 | 59.2 | 51.4 |
| 40-60-0 | 49.7 | 46.5 | 56.4 | 63.0 | 43.2 |
| 40-0-0 | 37.1 | 53.3 | 57.6 | 53.0 | 41.1 |

*The first figure refers to pounds nitrogen, the second to pounds of phosphorus pentoxide, and the third to pounds potassium oxide applied per acre.

of oats can be obtained when good soil fertility practices are used.

The results of the 1953 outlying soil fertility trials on corn show that nitrogen is usually the most deficient plant food element for corn production. The greatest response to fertilizers, especially nitrogen, will be obtained on those soils which have been under continuous cropping. Where the nitrogen requirements of the corn crop have been supplied by a good rotation, including a legume or application of manure, the response to commercial fertilizer will probably be small.

Table 2, Effect of Soil Treatments on Yield of Oats, Agronomy Farm, Brookings, South Dakota, 1953

| | Bu/A |
|--|------|
| No crop residues returned | 40.4 |
| Residues returned | 45.5 |
| Manure | 61.5 |
| Nitrogen fertilizer (20-0-0) | 64.5 |
| Nitrogen and Phosphorus fertilizer (20-20-0) | 69.0 |

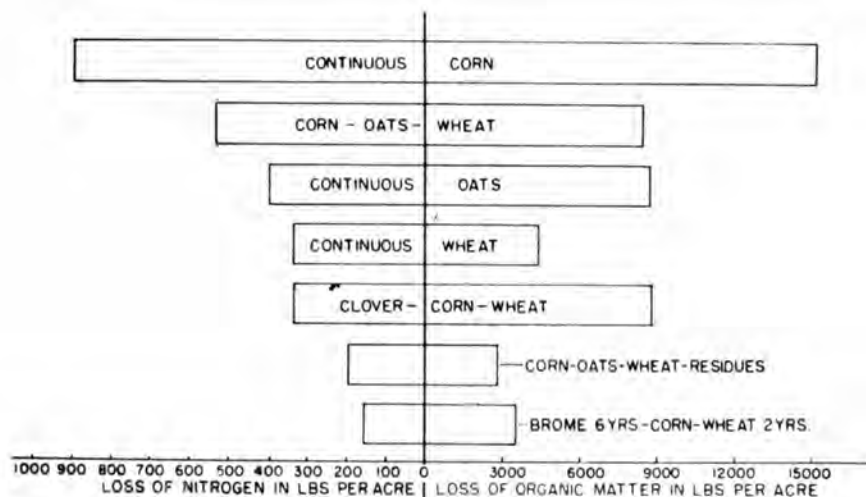
In the spring wheat area, nitrogen deficiencies are more general and pronounced than phosphate deficiencies. Fertilizer response this year and in previous years show that larger and more consistent responses are obtained from the application of nitrogen than from phosphate fertilizer. The eastern part of the spring wheat area gives more response to phosphate fertilizer than the central area. At Brookings nitrogen and phosphorus fertilizer increased the yield of spring wheat approximately 6 bushels per acre. (Project 46. Leaders: L. F. Puhr and W. W. Worzella, Agronomy Dept.)

Experiments Initiated on Claypan Soil

Special funds were provided this past year for organic matter and soil structure research. The research is to be conducted for the most part on a claypan soil near Plankinton, South Dakota. Ten acres have been leased and 10 different rotations will be used in the experiment. The rotations will include

Effect of cropping practices on the rate of depletion of soil nitrogen and organic matter from 1942-1950

EFFECT OF CROPPING SYSTEMS ON LOSS OF SOIL ORGANIC MATTER AND NITROGEN





The relative yields of corn from plots treated with 0, 30, 60, and 120 pounds of nitrogen respectively, left to right. Don Peck farm Angostura project

such legumes as alfalfa, sweet clover, and a non-hardy variety of alfalfa. The need for fertilizer will also be investigated.

Bulk soil from the experimental area was used in the greenhouse during the winter. Different combinations of nitrogen, phosphorus, potassium, and synthetic soil conditioner were used in three different experiments. Phosphorus proved to be the most limiting fertilizer element in the surface soil. Soil conditioners had little or no effect on the surface soil, but did increase the yield when the subsurface soil (claypan) was used.

A number of experiments where fall application of fertilizer was compared to spring application was conducted on private farms in the western part of South Dakota. It appears from the year's results that oats, barley, and spring wheat yielded just as well or a little more if the fertilizer was put on in the spring rather than in the fall. The differences, where present, were not statistically significant. Nitrogen in nearly all experiments gave a significant increase while phosphorus gave very little or no increase.

Four deep tillage experiments were set up in Bon Homme, Hutchinson, and Douglas counties in the fall of 1952. Strips were laid out on small grain land where some strips were deep chiseled

and the others were not. Four replications or more were included in each experiment. Corn was the crop grown in 1953 at each of the experiment sites. Corn yields were taken and the differences in yield were very small and statistically insignificant. (Project 4. Leader: B. Brage, Agronomy Dept.)

Soil Testing Increasing

The laboratory tested approximately 3,300 soil samples during the year; 87 percent of these were submitted by farmers. Recommendations for the use of commercial fertilizer were made when the tests and past management indicated there was a good chance of obtaining a profitable yield increase or where added fertility was needed to help establish a new legume or grass stand.

Soil samples from soil fertility experimental plots and fertilizer demonstration plots were tested. These experiments and demonstrations represented the soil and growing conditions found throughout the state.

The testing of water samples to determine their quality for irrigation purposes was started. Approximately 112 samples were tested for South Dakota farmers. (Project 172. Leaders: Paul L. Carson and Edward J. Williamson, Agronomy Dept.)



In experiments using fertilizer and soil conditioner on claypan soil phosphorus (P) alone gave a greater increase in yield than nitrogen (N) alone, but nitrogen plus phosphorus produced a still larger yield. The use of soil conditioner (Kr) with nitrogen and phosphorus did not give any further significant increase in yield

Irrigation Research in the More Humid Sections of South Dakota

The production of corn, soybeans, and hay crops received special emphasis in experiments conducted during 1953. In corn production, experiments at Redfield and Angostura showed the need of a combination of the factors of adequate plant population (about 18,000 to 20,000 plants per acre), high fertility levels, and irrigation at critical periods.

Soybean experiments indicated an over-all yield advantage of 27.5 percent of 18-inch rows over 36-inch rows, all varieties considered. Capitol, Ottawa mandarin, and Blackhawk had about the same yield potentials when all moisture levels and 18- and 36-inch row spacings were averaged. Irrigation was of definite advantage, even in the relatively wet year of 1953.

Hay production experiments initiated in earlier years continued to show very marked yield response to nitrogen fertilizer with all tame grasses tested. However, use of alfalfa in combination with grasses resulted in as great a yield as the use of commercial nitrogen at the rate of 80 pounds per acre.

Rotation experiments initiated in 1949 are being continued. Fertilizer studies incorporated within these rotation experiments have provided a means of comparing the efficiency of alfalfa in a rotation with commercial fertilizer as the two affect the yield of corn and wheat. Under both irrigated and nonirrigated conditions, two years' growth of alfalfa appears to have about the same nitrogen-supplying value as 60 pounds of nitrogen per acre applied as commercial fertilizer.

Water quality studies begun at the Shadehill Development farm are being continued. Greenhouse and laboratory work indicate that soil deterioration may be serious with the high sodium, high bicarbonate type of water being impounded in the Shadehill reservoir unless proper soil amendatory practices are used in conjunction with the irrigation water. Studies on the use of gypsum with this water are continuing. (Project 173. Leaders: L. O. Fine, R. E. Campbell, and F. Wiersma, Agronomy Dept. and USDA cooperating.)

Progress Is Being Made in Breeding New Varieties of Small Grains

Proper varietal choices will go far toward protecting the grower's investment in soil fertility and good management practices. Where these were followed, very high yields were obtained in 1953 from oat varieties like Mo-0-205, Vikota, Cherokee, Nemaha, Dupree, and Waubay. The latter two varieties, described in Bulletin 436, were released for 1954 planting. Artificial drought studies made during the past year indicated that Dupree, Andrew, and Nemaha had a high level of heat resistance in comparison to varieties like Branch and Richland.

Breeding wheats for resistance to race 15B of stem rust involves a vast cooperative effort, including research workers in Mexico, Canada, the USDA, and the wheat states. The variety Selkirk, developed in Canada, was released to South Dakota growers the winter of 1953. It combines good milling qualities with considerable resistance to race 15B. A variety with a different base of rust resistance, Willet, which was developed by the USDA at Minnesota, is now on increase. Durum wheat selections first tested in 1953 are very promising. 1953 yields indicated very definitely that of varieties of spring wheat now generally available to growers, Rushmore has the most tolerance to rust and the best yield record under disease conditions, as well as under dry-land conditions. The use

of Rushmore was worth 6 million dollars in 1953 to South Dakota growers. This estimate is based on the 2-3 bushel yield advantage Rushmore held over Mida and Rival throughout the state and the acreage of Rushmore grown.

Winter survival continues to be the major problem in winter wheat. Breeding for additional winter hardiness is a very important approach to the problem. In rye, winter hardiness of the best present varieties appears adequate. Efforts to develop new breeding methods to raise the yield level in rye are being continued.

The search for more profitable and adapted barley varieties is showing progress. Five lines which showed high promise in preliminary tests have been entered in the regional testing program. Feed and malting qualities of these five are being evaluated. Efforts are also being directed toward the improvement of our standard malting variety, Odessa C.I. 182, through programs of irradiation and backcrossing. Possible resistance to barley scab was observed in 1953 indicating that it may be possible to produce barley varieties that can be grown successfully in the corn areas of the state.

Two plant breeding approaches are being used to maintain and improve the productivity of flax. The first involves the standard methods of hybridization followed by selection of desirable types from progeny of the crosses. Numerous lines derived from this crossing program are being tested; some appear to have promise. Fiber flaxes and Indian lines have been included in this program to broaden the genetic base of the crop. The second approach involves the use of mutagenic agents on some present varieties and crosses. Atomic and X-irradiation, as well as chemical mutagens, are producing genetic effects on flax; some of these changes may have economic significance. (Project 181 and 25. Leaders: V. A. Dirks and D. D. Harpstead, Agronomy Dept.)

Grain and Forage Sorghum Testing and Breeding

The grain yields of the named varieties tested at five locations in the sorghum adaptation test show that the adapted varieties Reliance and Norghum produced the highest yields of grain. The other varieties except Early Kalo and Improved Coes did not produce matured grain. This probably was the chief reason the other varieties produced much less grain per acre.

In the 1953 adaptation test there were 35 strains and varieties of grain sorghum, 6 varieties of forage sorghum, and 3 varieties of Sudan grass. Also at four of the locations there were 51 strains of sorghum from six states tested in a Uniform Regional Sorghum Nursery. These strains are the most promising material from the sorghum breeders. The materials tested are called strains before they are named and released. It is important to know the extent of their adaptability.

Seventeen hundred strains and segregating populations of grain sorghum, forage sorghum, and Sudan grass were grown in the breeding nursery, and evaluated for good agronomic characteristics. All of the strains and crosses grown were treated with colchicine. Many new and better types of sorghum are being produced with colchicine treatment. (Project 61. Leader: C. J. Franzke, Agronomy Dept.)



Variations created in sorghum by treating with colchicine. From left to right; untreated, treated, and re-treated

Soybeans, Sunflowers, Safflowers, Castor Beans, and Millet Improvement

Soybeans are becoming a very important cash crop in South Dakota. Therefore, adaptation trials are being conducted on standard varieties and promising new selections at three maturity zones. This test is in cooperation with the Regional Soybean Laboratory of the USDA.

The maturity zones or belts are designated as: group O the early maturing varieties for the northern section of the

Table 3. 1953 Sorghum Variety Yields at Five Locations

| Variety | Brookings | Highmore | Kennebec | Hot Springs | Newell (Dry Land) | Newell (Irrigation) | Av. Yield |
|---------------|-----------|----------|----------|-------------|----------------------|------------------------|--------------|
| Norghum | 71.8 | 87.4 | 88.9 | 46.8 | 37.4 | 65.5 | 66.3 |
| Reliance | 71.8 | 92.1 | 86.2 | 57.7 | 39.0 | 71.8 | 69.8 |
| Martin | 39.0 | 62.4 | 51.5 | 45.2 | 21.8 | 21.8 | 40.3 |
| Early Kalo | 57.7 | 84.7 | 70.2 | 37.4 | 28.1 | 34.7 | 53.6 |
| Improved Coes | 39.0 | 76.4 | 48.4 | 40.6 | 18.7 | 43.7 | 44.5 |
| Westland | 20.3 | 76.4 | 40.6 | 53.0 | 9.4 | 42.1 | 40.3 |
| Midland | 23.4 | 42.4 | 43.7 | 37.4 | 15.6 | 45.2 | 34.6 |
| Sooner Milo | 35.9 | 74.9 | 59.3 | 46.8 | 39.0 | 62.4 | 53.1 |

state; group I the medium early maturing varieties for the central part of the state; and group II the later maturing varieties for the southern section of the state. The information from the results of the adaptation tests and the evaluating strains and varieties in the three maturity zones is valuable in recommending varieties to farmers. The testing of new germplasm in these areas likewise enables the Experiment Station to evaluate their agronomic value for future increase and release.

Thirty soybean crosses were secured from the Iowa Agricultural Experiment Station. Part of the seed of these crosses was grown in the greenhouse during the winter and treated with colchicine. This material will be studied and selected for yield, maturity, lodging, height, seed quality, seed size, and shattering. Likewise, germplasm is being gathered for a soybean breeding program.

In 1953, 53 castor bean strains, 85 sunflower strains, 7 safflower strains, and 25 millet strains were appraised and evaluated in an observation nursery. These crops are being studied for their good agronomic characteristics and their possibilities as a special crop for South Dakota. (Project 148. Leader: C. J. Franzke, Agronomy Dept.)

Experiment Station Corn Hybrids Yield High

Yield tests on commercial corn varieties were conducted at 12 locations in 1953. The purpose of the work was to supply farmers with information on the relative performing ability of the popular hybrids being sold in the state. It is one of the services rendered annually by the South Dakota State College Agricultural Experiment Station.

At least one trial was placed in each of the eight agricultural areas into which the state has been divided. Plots were planted near Newell, Vale, Cottonwood, Eureka, Highmore, Claremont, Redfield (two plots), Brookings, Cham-

berlain, Ethan, Dell Rapids, and Wankonda.

The trials varied in size from 12 to 30 entries depending on the agricultural area and amount of available land. Information obtained included yield and percent of moisture at harvest, the latter indicating relative maturities. Where possible lodging data were also taken. Up to 5-year averages were calculated for entries tested more than 1 year. These results are given in South Dakota Agricultural Experiment Station Circular 97. In these trials, South Dakota Experiment Station corn hybrids were top-yielders in 8 out of the 12 locations.

In general, precipitation was above normal for 1953, with temperatures nearly normal in most areas, resulting in one of the best corn years South Dakota has had for both yield and quality of grain produced. (Project 151. Leaders: D. B. Shank and D. E. Kratochvil, Agronomy Dept.)

Forage Legumes Being Improved

Intensive study has been directed at two groups of selected alfalfa clones and their intercross progeny. In group I (the H2 matrix) selection of parental clones was for wilt resistance, resistance to common leaf spot caused by *Pseudopeziza medicaginis*, and for the wide, low crown. Marked success has attended the efforts with respect to the leaf spot resistance.

In the field in late 1953, 440 progeny plants of the H2 matrix were scored for reaction to leaf spot; 337 of these appeared resistant. These plants were re-scored on the basis of a greenhouse test in the spring of 1954 and a highly significant correlation of $+0.70$ was obtained measuring the relationship between the two tests. Because of greater environmental effects, selection intensity was not as great for reaction to bacterial wilt or for crown spread. The progeny tests measuring progress for these latter objectives are not completed at this time.

Greenhouse screening tests of the H2 material for reaction to diseases caused by *Ascochyta imperfecta*, *Cercospora zebrina*, and *Pseudopeziza jonesii* were also carried out. This disease work was conducted cooperatively with the Plant Pathology Department. Results of these tests have not been decisive, but it is believed that the lines show enough genetic variation to make selection effective, though immediate progress is not expected to be rapid.

The group III material (CK matrix) was selected initially for the proliferous-root habit. In 1954 intercross progeny of the selected parents was showing this behavior in markedly varying proportions; thus selection among the parents on the basis of the progeny test should be effective in isolating those parental clones with superior combining ability for this characteristic. These progenies also differ significantly for reaction to rust and common leafspot.

Some initial work was started with diploid alfalfa, and work with selections of sweet clover and birdsfoot trefoil has continued.

Strain testing in pastures and hay trials are in progress. New seedlings were made at the Redfield Irrigation Development Farm. Seed of some locally adapted trefoil material in sufficient quantities for preliminary plot testing has been produced. The trueness-to-type test of alfalfa seed produced outside the region of primary adaptation has shown some striking intra-varietal differences. Certified seed in all cases performed in a manner characteristic of the true variety. (Project 74. Leader: M. W. Adams, Agronomy Dept.)

Thousands of Grass Strains Evaluated

New varieties of smooth brome, Ree wheatgrass and crested wheatgrass with increased adaptation and usefulness are being bred by selection and inter-breeding. Smooth brome is being selected particularly for resistance

to leaf diseases, Ree wheatgrass for seed set, and crested wheatgrass for yield, seed size, and root rot resistance.

Reserves of germplasm are maintained for selection of desirable new genotypes. Large seeded grasses resulting from crosses involving perennial grasses and cereal grains are being selected for winter hardiness both under natural conditions and by artificial freezing tests. Cytological and genetical studies of these selections as well as colchicine induced variants are being made.

In the greenhouse selected clones of the grasses are crossed. Seed from these crosses as well as seed previously selected in the field are planted in the greenhouse and later transplanted into the field.

Approximately 8,000 plants have been placed in the field for evaluation in the spring of 1954. Strains and varieties of these grasses are being tested for yielding ability and adaptability.

The superiority of grasses and legumes in a mixture over grass by itself has been demonstrated. Ree wheatgrass and Homesteader brome in general have been the outstanding varieties. (Project 182. Leader: J. Ross, Agronomy Dept.)

New Research Pastures Started

Fifty acres of land, representative of a large area of soil found in eastern South Dakota, were set aside for the pasture experiment. After making a detailed soil survey and analysis of the soil, the area was divided into six uniform pastures, each 8 acres in size.

Three types of pastures were used, and two paddocks were seeded to each of the following grasses and legumes: brome, alfalfa-brome, and sweet clover-rye. The pastures were fertilized to maintain a constant productivity of the soil. The rate of fertilization was as follows: brome—200 pounds of 33-0-0, and 50 pounds of 0-43-0; alfalfa-

brome, 100 pounds of 0-43-0; and sweet clover-rye, 100 pounds of 0-43-0. The fertilizer was applied on the surface in the fall of 1952. Each paddock was divided in half with a fence so that the livestock could be rotated for better utilization and management. In general the livestock were rotated every 2 weeks.

In order to estimate the amount of forage consumed each month by the livestock, several cages were placed in each paddock. At 2-week intervals and immediately after the cattle had been rotated to the alternate half of the paddock, forage clippings were made. Clippings were made from the known area that was protected by the cage (not grazed) as well as from a similar area that was grazed. The clippings from each were kept separate, dried, weighed, and the amount of forage was determined. The difference between the

weight of the forage obtained from the cages and that left after grazing is assumed to be the amount utilized by the livestock. For the 1953-54 season the following average amounts of forage were consumed: brome—4,144 pounds; alfalfa-brome — 6,272 pounds; and, sweet clover-rye—3,479 pounds per acre. The results obtained with livestock are reported under "Livestock Production." (Project 225. Leader: W. W. Worzella, Agronomy Dept.; F. W. Crandall, Animal Husbandry Dept.)

Getting a Good Stand of Corn, see page 23

New Corn Hybrid—South Dakota 250, see page 41

Precaution When Using Chemicals for Weed Control, see page 49

Soil Survey—Spink County, see page 86

Agricultural Chemistry

Selenium Poisoning

It has been observed that cattle on highly seleniferous ranges are not protected from selenium poisoning by the use of salt containing sodium arsenite at recommended levels. To determine the reliability of this observation, 28 yearling cattle were placed on experiment at Reed's Ranch, a known seleniferous location. After one year's study, it appears that salt containing 35 parts per million of arsenic does not significantly reduce the symptoms of selenium poisoning. One more year of work will be needed to establish this.

Requests are often received for the diagnosis of what appears to be chronic selenium poisoning in cattle. Analysis of feeds on pastures is of doubtful value in these cases. It has been found that the analysis of the blood is a fairly reliable means of diagnosing chronic selenium poisoning. Hair analysis is even more accurate and, from the standpoint of sample collection, far more convenient.

Fractionation of linseed oil meal to obtain the factor in it that protects against selenium poisoning was continued. This factor is now known to be insoluble in hexane, acetone, and absolute ethanol, soluble in 50 percent ethanol and in water, heat stable, and not present in the ash. It has been concentrated about 10 fold, and experiments now in progress should give a considerably greater purification. This factor, when it has been identified, may play an important role in the control of chronic selenium poisoning.

Studies on the effect of organic arsenicals on chronic selenium poisoning in the rat have been continued, and this work has been extended to include studies with swine. The first study with swine has demonstrated that when used at levels found safe to feed to poultry two arsenicals (arsanilic acid and 3-nitro-4-hydroxyphenylarsonic acid) give good protection. Further work with hogs is now in progress.

The physiology of selenium has also been investigated. The purpose of these studies is to determine why selenium causes the symptoms that it does and why arsenic overcomes them. Knowing this, the prevention or treatment of the poisoning should be easier. One of the most interesting findings of this study is the fact that selenium possibly interferes with phosphorus metabolism.

Radioactive selenium and sulfur again have been used as tracers in determining how plants use these two elements. In selenium indicator plants it appears that most of the selenium occurs combined with one type of compound, the identity of which is yet to be established. (Project 19. Leaders: O. E. Olson, A. W. Halverson, E. I. Whitehead, C. W. Bonhorst, Station Biochemistry; C. A. Dinkel, R. Wahlstrom, Animal Husbandry Dept.)

Trace Mineral Studies

The cobalt content of western wheatgrass from various parts of the state is being investigated to determine whether or not areas deficient in this trace mineral exist. Of 28 samples analyzed to date, 19 have contained less than 0.07 parts per million of cobalt, and four have contained less than 0.04 parts per million. These data indicate that cobalt may be a limiting element in much of our grazing land. Further work will be done to establish whether or not such is the case.

The effect of trace minerals and certain other ingredients upon vitamin A stability in mixed poultry rations was studied. Fish oil and, especially, wax-sealed vitamin A showed lesser losses during storage than had carotene in various forms. As was the case with carotene, the stability of the vitamin A supplements in the various rations used was adversely affected by the presence of trace minerals. (Project 180. Leaders: G. F. Gastler and A. W. Halverson, Station Biochemistry.)

Treatment of Hard Waters for Household, Farm, and Dairy Use

Methods which had previously been worked out on this project were used in laundrometer studies. These studies were made to determine the effect on dirt removal from soiled fabric of the rate of addition of various packaged softeners along with soap. Several levels (0, 15, 30, 60, and 120 grains per gallons) of hardness of water were used in these studies.

Some of the softeners gave optimum dirt removal only at a rather definite rate of addition. This depended upon the hardness of the water. Others were effective over a rather wide range of concentrations. These findings, along with other information concerning packaged softeners, will be helpful in solving the hard water problem in connection with farm laundering.

In addition to packaged softeners, several detergents are being tested. The results of these tests are not complete, but the work should be finished during the next year. (Project 193. Leaders: O. E. Olson, G. F. Gastler, Station Biochemistry; L. Lund, Home Economics Dept.; D. F. Breazeale, Dairy Dept.)

Nitrate Poisoning

In an effort to establish whether or not herbicide application may cause nitrate accumulation in plants, an experiment using four kinds of weeds and sugar beets was undertaken. These plants were grown on both unfertilized and nitrate fertilized soils and were treated with several levels of 2,4-D. At 3, 9, 15, and 21 days after treatment, the plants were analyzed for nitrates. Whereas nitrate fertilization caused increases in the nitrate contents of the plants, the results with 2,4-D were variable. It appeared, however, that the herbicide had little effect on the nitrate content of most of the plants.

Waters with high nitrate content have been implicated in several cases of cat-

tle losses. To study the effect of high nitrate content water on sheep, the animals were given water to which this chemical had been added at different levels. Even when amounts of nitrate far in excess of that found in any naturally occurring waters were used no toxic symptoms were observed. Sheep appear tolerant to nitrates, but many factors which could reduce this tolerance need study.

In view of the high nitrate content of some well waters, it seemed that pond waters should be investigated. Samples taken in the spring and in the fall from 33 locations in eastern South Dakota were analyzed. None showed more than a trace of nitrates. (Project 87. Leaders: E. I. Whitehead, Station Biochemistry; L. Derscheid, Agronomy Dept.)

Barley Proteins

In earlier studies it was found that barley of high protein content differs from that of low protein content in the relative amounts of various protein fractions. It is to be expected, therefore, that the feeding value of barley proteins should vary with their content of this nutrient.

In order to determine the direction and degree of change in the nutritive value with increasing protein content, studies on the amino acid contents of the protein fractions have been started. The data obtained to the present time do not indicate any definite trend as far as amino acid content of the alcohol soluble fraction of barley of different protein contents is concerned, but further work is necessary before conclusions can be drawn. (Project 195. Leaders: A. W. Halverson, F. M. Moyer, Station Biochemistry.)

Hog Marking

Many methods of marking hogs, either for short or long time periods, have been investigated. Two types of marking solutions, different from those pre-

viously reported, appear to have possibilities. One of these gives a mark which is good for at least 4 weeks, but it is not permanent. The other gives a purple mark for 1 to 2 weeks, and at about 3 weeks brands the animal. Both are very resistant to scrubbing.

Neither of these marking solutions shows up well on a black hog, except, of course, that the brand that forms shows on any color animal. For certain purposes the marking solutions are quite satisfactory. A simple method of application has also been devised. (Project 235. Leaders L. D. Kamstra, Station Biochemistry; R. Wahlstrom, Animal Husbandry Dept.)

Chemical Analysis of Grass Silage with Different Methods of Storage

Nutrient loss studies were made on alfalfa and on oat silage stored under several conditions by a method that permitted the determination of the degrees of loss at various locations throughout the stacks or silos.

It was found that when air was not excluded losses in dry matter through fermentation were very high. The degree of loss appeared to depend upon the ease of penetration of air.

The chemical composition of the silage at locations where dry matter losses were high was somewhat different than for that where such losses were low. By far the most marked change was in carotene content, which was reduced to extremely low values when air was not excluded. The results of this study point to a need for further work on methods of preserving the nutrients of grasses stored in the more open types of silos such as stacks and uncovered trenches. (Project 237. Leaders: O. E. Olson, A. W. Halverson, Station Biochemistry.)

Cornstalk Poisoning, see page 8

Analyzing Feeds for Poisons, see page 56

Feed Analysis, see page 83

Crop Insects

European Corn Borer

In 1953 the estimated production of corn grown for grain in South Dakota amounted to 124,605,000 bushels. The estimated loss, due to the European corn borer, amounted to 10,579,439 bushels (at \$1.27 per bushel, the loss was \$13,435,887). This amounts to approximately 8.5 percent of the crop. These estimates are based upon South Dakota State College Agricultural Experiment Station fall survey figures, and the State Crop Reporting Service figures (Bureau of Agricultural Economics). The computations were made by personnel of the Federal European Corn Borer Laboratory at Ankeny, Iowa.

Experiments have indicated that substantial savings can be obtained by timely application of chemical controls used against the borer in heavily infested corn fields. Pamphlets and reprints issued by the Entomology-Zoology Department list a series of controls designed to reduce corn borer populations. These are available upon request.

Spring 1954 studies of overwintering of the borer indicate a mortality of only about 20 percent (80 percent survival). With favorable weather conditions at the time the moths emerge and lay their eggs this population level could produce a serious infestation.

A small, wasp-like corn borer parasite, *Sympesis viridulus*, has been found to be present over most of the eastern half of South Dakota. This parasite is not present in large enough numbers to reduce greatly the borer populations, however, it is one of the natural aids in borer control. (Project 187. Leader: Gerald B. Spawn, Entomology-Zoology Dept.)

Corn Rootworm

Corn rootworms, *Diabrotica* spp., have been receiving an increasing

amount of attention in the North Central Corn States recently.

The damage done by the larvae of these insects results in the destruction of corn roots, as the name implies. Since the damage is underground it is rather difficult to evaluate. In heavily infested fields, where the majority of corn roots are destroyed, strong winds often blow the stalks over on their sides. The stalks then are unable to straighten up, but, if they continue to grow, will go straight up from the tip. This results in a crooked stalk which is difficult to harvest. If a large percentage of the stalks are in this condition the use of a mechanical corn picker is difficult. In addition, the yield from infested stalks is reduced when a large proportion of the roots are injured by the larvae.

The northern corn rootworm, *D. longicornis* (Say), is apparently the most prevalent form in South Dakota. Damage from this species can be greatly reduced if proper rotation of crops is practiced. Corn should not follow corn on a given field.

Chemical controls are being studied and a report on the experiments will be published later. (Project 247. Leader: Gerald B. Spawn, Entomology-Zoology Dept.)

Grasshopper Studies

One hundred and four species and varieties of grasshoppers have been recorded for South Dakota. Five of these species overwinter in South Dakota in a nymphal or immature stage, while all the remainder overwinter in the egg stage. The species that have been found to overwinter in a nymphal stage are the following: (1) *Arphia conspersa*, (2) *Xanthippus corallipes*, (3) *Psoloessa delicatula*, (4) *Erritettix simplex*, and (5) *Chartophaga viridifasciata*. The grasshoppers numbered 3 and 4 occur in the largest numbers each year, but they

are not large in body size. Grasshoppers numbers 1, 2, and 5 have not been abundant anywhere in South Dakota during the past 45 years but since they are large and have colored hind wings, they are conspicuous and often noticed. The five species listed, mature in the spring and are the first grasshoppers to become adult. These grasshoppers become adults in May and June, lay their eggs in July, and by the end of July most of them have died.

The remainder of South Dakota species of grasshoppers overwinter in the egg stage. These grasshoppers may be divided roughly into three groups: (1) those whose eggs hatch early, usually during May; (2) an intermediate group whose eggs usually begin to hatch during June and continue to hatch to mid-July; (3) a late group whose eggs begin to hatch during the latter half of June and may continue to hatch through the entire month of July.

It should be understood that the hatching date of grasshopper eggs is dependent not only on the species of grasshopper that laid the eggs, but upon many ecological factors in addition. Some of the most important of these factors are: temperature during April, May, or June; soil moisture; color and texture of the soil; slope of land where eggs are located; and cover or plant growth on the soil where eggs are found.

In general, the three groups of grasshoppers that winter over in the egg stage require from 35 to 60 days for the grasshoppers to mature (from time of hatching to adult grasshoppers). The length of the developmental period is dependent upon the species of grasshopper concerned and upon ecological factors, chief of which is temperature.

Grasshoppers in a field, or field margin, or on a range, should be destroyed with one application of a spray or dust or poison bait, if possible, in order to save expense and labor. The application

should be made after the eggs have hatched and before any maturing grasshoppers have begun to lay eggs, provided no serious damage occurs through the feeding of the grasshoppers. This is especially important when the control of range grasshoppers is being considered. When eggs of crop infesting grasshoppers have been laid in field margins, in road-sides, or headlands, and if more than one species of grasshoppers is involved, or if there is an uneven hatch of the eggs, it may be desirable to make two applications of sprays or dusts well spaced to keep the grasshoppers from moving into and damaging the crop.

If the grasshoppers have already invaded the edges of a crop from a grass margin or road-side, it is important to spray or dust not only the field margin of grass and the outer border of the crop, but in addition to spray or dust a short distance ahead of the grasshoppers in the cropland. Should an entire field of small grain be infested with grasshoppers, it may be necessary to spray or dust the entire field if damage is to be avoided.

The grower has a good choice of insecticides from which to choose. When making his choice he should consider the cost of the insecticide that is to be used per pound per acre, quantity that is to be used per acre, and the residual action (length of time the insecticide kills grasshoppers after it is applied). In general it is more economical and otherwise satisfactory to spray than to dust. If the use of poison bait is being considered, this should be done in connection with the control of grasshoppers on range land, or in winter wheat or rye. The cost of controlling grasshoppers on an acre of land should be figured not on a 1-year basis, but on a basis of 3 or more years. If a thorough job of destroying grasshoppers is done, the job remains effective for several years and no further control spraying or dusting may be necessary. (Project 18. Leader: H. C. Severin, Entomology-Zoology Dept.)

The Tree hoppers or Membracidae of South Dakota

The tree hopper or Membracidae constitute a family of bugs which are represented in South Dakota by a fairly large number of species. Several different kinds of tree hoppers harmful to man's interests occur in the state, but the outstanding species is the Buffalo tree hopper, *Stictocephala bubalis* (Fab.). This tree hopper is harmful to fruit trees and many shade trees, not because of its feeding activities, but because of the scars that it produces in the younger twigs by its egg-laying habits. The scars increase in size as the twigs grow. The result is a very gnarly growth. The affected areas later become brittle.

A collection of at least 10,000 specimens of tree hoppers has been made in South Dakota. These have been properly pinned, labeled with date, locality, and collector's data, and are identified. A manuscript covering this family of bugs will be prepared during the next year. (Project 220. Leader: H. C. Severin, Entomology-Zoology Dept.)

The Ladybird Beetles or Coccinellidae of South Dakota

The Coccinellidae comprise a family of beetles known as ladybird or ladybug beetles. The family is a medium-sized one so far as number of species is concerned. In South Dakota between 50 and 60 species have been discovered. To the average layman a ladybird beetle is a hemispherical beetle about a quarter of an inch or less in length, winged, and generally red or yellow in color with black spots or markings or black with white, yellow, or red spots. However,

there are many species of ladybird beetles that are totally black or black shading into brown with no dots or other markings. Some of these species may be extremely small and may not be larger than the head of an ordinary pin.

The only leaf-eating species found in South Dakota is the Mexican Bean Beetle, *Epilachna varivestis* Mulsant. This species occurs in the Black Hills area and immediately east of the Hills. Here it is a serious pest of garden and field beans, soybeans, and cowpeas. When infestation is severe it may attack alfalfa, clover, vetches, some grasses and weeds.

All of the remainder of the South Dakota species of ladybird beetles are carnivorous, both in their larval and adult stages. They feed upon small insects and upon the eggs of both small and large insects. Many ladybird beetles are well known and their presence is considered highly desirable because they feed upon aphids or plant lice, psyllids or jumping plant lice, and scale insects. The aid of certain species of Coccinellids is, at times, very considerable in reducing insect pests.

About 5,000 specimens of ladybird beetles have been collected over South Dakota. These have been labeled with locality, date and collector's labels, and have been identified according to the species or variety. A manuscript on ladybird beetles is in preparation. (Project 220. Leader: H. C. Severin, Entomology-Zoology Dept.)

Oyster-shell Scale, see page 43

Fly Control on the Farm, see page 52

Maggots Found Infesting Corn Silage, see page 78

Fruits, Vegetables, and Shelterbelts

Breeding for Better Tree Fruits

Individual tree ratings for date of blooming, fireblight resistance, and fruit production were made for apple,

pear, plum, apricot, and some cherry trees growing in the Station orchards. This information when accumulated over a period of years will prove valu-

able in making selections and also be useful in the breeding program.

Apple, pear, and apricot varieties of high quality were crossed with those possessing hardiness, disease resistance, and other desirable characteristics. Nine hundred seedlings resulting from similar crosses made last year are now being grown in the greenhouse, thereby saving 2 or 3 years time in the earliness of their fruiting and also reducing labor costs considerably. Experiments are being conducted in an attempt to determine hardiness in the early stages of growth. (Project 1. Leader: R. M. Peterson, Horticulture and Forestry Dept.)

Tomato Hybrid SD 65 Named State Fair

Tomato hybrid SD 65, which has been tested throughout the state during the past few years, has been given the name State Fair. Reports from trial plantings by home gardeners have been highly favorable. The fruit is firm fleshed with an excellent appearance, both in shape and color. The deep globe fruit shape is distinctive.

Since State Fair is not extremely early, it is recommended that home gardeners plant it along with an earlier variety such as Siouxann. It does yield heavily when its season begins.

In a preliminary storage test of several varieties and hybrids, it was observed that State Fair kept exceptionally well as a green wrap. Thus, the large numbers of green fruits on the vine in the fall, after ripe tomatoes have been picked during the summer, may be an advantage for growers wanting high quality green wraps. (Project 49. Leader: R. L. Foskett, Horticulture and Forestry Dept.)

Twelve Sweet Corn Inbreds Released

The South Dakota State College Agricultural Experiment Station sweet corn breeding project was terminated with the release of 12 inbred lines. Since

1937 this station has been developing lines for hybrid sweet corn especially suited to this area. The 12 inbreds that have shown the best results in test crosses are the following: 42, 176, 226, 277, 469, 592, 789, 829, 883, 884, 908, and 909.

Seed samples and brief descriptions of the 12 inbred lines are available to experiment station workers and commercial corn breeders. It is hoped that these lines will be found useful in a number of breeding programs for various purposes. At this station they have all been found to produce good hybrid sweet corn when crossed. (Project 68. Leader: R. L. Foskett, Horticulture and Forestry Dept.)

Wind Protection Increases Vegetable Yields

A study of the value of wind protection to vegetables was undertaken at Redfield in 1953. A 50-foot section of snow fence, 4 feet high, was erected as a wind barrier across the middle of a field of Butternut squash. Yields were taken at various distances from the fence in pounds of ripe fruit per hill in one harvest. Seeds were planted on June 4 and the fence was erected July 7.

The average yield from the hills in the first row north of the fence was 15.5 pounds. As the distance from the fence increased, yields decreased. Average yield per hill from the third row north of this first row (the fourth row from the fence) was 5.75 pounds, little more than one-third as much.

If hills in which all plants were killed are included in the average yield, then the first and fourth rows from the wind barrier varied by more than four times the yield. Apparently some plants were killed by wind damage, since most of the hills with no plants at harvest time were found some distance away from the fence.

The rows south of the fence showed similar results to those north of the

fence. However, all yields of plants south of the fence were lower, presumably because of the prevailing southerly winds. (Project 118. Leader: R. L. Foscett, Horticulture and Forestry Dept.)

Seedling Caliper Affected by Sowing Rate

One-year results testing various sowing rates of Chinkota elm seed indicate that caliper (diameter at the root collar) is strongly affected by the density of the stand. Using 7/32 inches as the minimum acceptable caliper for quality stock, a final stand of 5 stems per linear foot graded out 75 percent as acceptable; increasing the number of seedlings per foot decreased the grade out to the point where 25 stems per foot yielded less than 30 percent acceptable stock. On the other hand, total yield of 7/32 inches or larger caliper stock increased as the density increased up to 20 seedlings per foot. Where seed is plentiful, the greatest yield of grade stock comes from sowings yielding a final stand of 20 stems per foot. Where seed is scarce, a final stand of 5-6 stems per foot is indicated. (Project 142. Leader: Paul E. Collins. Horticulture and Forestry Dept.)

Virus Disease Is Common in Strawberry Plantings

Because of the virus disease problem, it has been difficult to conduct experimental work with strawberries. Infected plants lack vigor, set few runners, produce small fruit and fail to survive. There is no treatment that will "cure" the disease.

Workers in the USDA found disease-free plants for most varieties. These were sent to commercial nurseries for increasing and some disease-free plants are now available. Eleven varieties from this source were planted at Brookings in 1953. They appear to be disease-free and a good crop is expected. It does not appear wise to start a new planting for anything other than virus-free plants. (Project 145. Leader: S. A. McCrory, Horticulture and Forestry Dept.)

Hansen Foundation Orchard

Twelve Sandcherries (*Prunus besseyi*) selected from many thousands offer much promise as a source of new stock. Seeds collected from these plants produce seedlings very similar to the parent plant. Since the fruit is good quality, these plants may serve a dual purpose in shelterbelts.

The sandcherry has been used as a rootstock for plums and apricots. It may have a much greater use for this purpose and is being used extensively. (Project 174. Leader: S. A. McCrory, Horticulture and Forestry Dept.)

Windbreak Spacing Study Initiated

In spring 1954 the first planting to test various between row spacings was made at Brookings. Spacings of 8, 16, and 24 feet between the rows were used; uniform spacing of 8 feet in the rows was used for all species except outside rows. Species included in the planting are Ponderosa pine, eastern redcedar, hackberry, Siberian elm and green ash. (Project 239. Leader: Paul E. Collins, Horticulture and Forestry Dept.)

Plant Diseases

Potato Diseases and Their Control

Nineteen varieties of potatoes were planted at Redfield in 1953. These included certain varieties which have been named recently and released by

the various experiment stations for scab resistance, quality and type, and the others used were standard varieties. The newer scab resistant varieties were compared with the standard varieties

under irrigated and nonirrigated conditions.

The purpose of these experiments was to determine whether or not scab and other potato diseases might become more damaging under irrigated conditions than under nonirrigated conditions. The plots for the irrigated and nonirrigated farming were on adjacent land to eliminate the effects of possible differences in soil characteristics.

In the fall when these plots were harvested it was found that there was a light infection of scab in the potatoes grown under both irrigated and nonirrigated conditions. The low intensity of scab was probably due to the fact that potatoes have not been grown on that particular ground for many years. The repeated cropping with potatoes in a rotation might well increase scab and certain other diseases.

Scab is frequently a cause for serious grade-out in South Dakota in order to meet U. S. grade standards. Further, there is no tolerance in the case of ring-

rot in meeting certification standards in South Dakota. It would appear that ring-rot would be a disease that would be highly favored by conditions of irrigation. Therefore, experimental data are needed to determine the influence of irrigation farming on the development and spread of the ring-rot and the major potato diseases.

The principal results obtained from these experiments in 1953 were the comparative yielding ability of the new scab resistant varieties with a number of popular varieties. The results are presented in the table.

Sixteen advanced lines from Louisiana were grown at Brookings in plots 25 feet long in four randomized blocks using four replications. Eight of these entries yielded over 350 bushels per acre, with LD 81-64, LD 81-99, LD 82-269, LD 92-105, and LD 92-216 giving the best over-all performance.

Also at Brookings, 15-hill rows of some 160 lines were planted in soil heavily infested with scab. Of this

Average Yields in Bushels Per Acre of Nineteen Potato Varieties Consisting of Commercial and the Newer Scab Resistant Releases Grown under Irrigated and Nonirrigated Conditions at Redfield, 1953

| Variety | Average Yield Bu./A.* | Rank in Yield | | Average Yield Bu./A.† |
|-----------------|--------------------------|---------------|-----------|--------------------------|
| | Nonirrigated | Nonirrigated | Irrigated | Irrigated |
| Kennebec | 307.1 | 1 | 2 | 423.1 |
| Cherokee | 285.8 | 2 | 10 | 330.9 |
| Irish Cobbler | 282.2 | 3 | 8 | 344.6 |
| LaSoda | 279.9 | 4 | 1 | 445.3 |
| Sebago | 267.4 | 5 | 5 | 359.5 |
| Columbia Russet | 260.3 | 6 | 4 | 391.0 |
| Chippewa | 246.0 | 7 | 3 | 406.6 |
| Keswick | 234.7 | 8 | 14 | 277.3 |
| Canso | 230.1 | 9 | 7 | 347.5 |
| Early Ohio | 226.4 | 10 | 6 | 358.0 |
| Katahdin | 222.2 | 11 | 9 | 338.9 |
| Red Pontiac | 214.5 | 12 | 12 | 314.1 |
| Russet Sebago | 211.0 | 13 | 13 | 301.5 |
| Yampa | 191.8 | 14 | 11 | 318.1 |
| Waseca | 189.4 | 15 | 15 | 243.7 |
| Bliss Triumph | 140.0 | 16 | 16 | 236.4 |
| Osage | 114.7 | 17 | 18 | 203.5 |
| White Cloud | 108.1 | 18 | 19 | 122.0 |
| Stark's Red | 94.9 | 19 | 17 | 208.4 |
| Average | 216.1 | | | 314.2 |

*Least significant difference: 5%—73.6; 1%—97.0.

†Least significant difference: 5%—152.3; 1%—202.8.

Sorghum Diseases and Their Control

Fungicidal seed treatment of sorghum was continued in 1953 with 12 of the materials which had produced the best results in former years being used on medium and late planted sorghum at Brookings and Highmore. Some of the materials were applied as dusts, others as a slurry or as a liquid.

Stand counts made at Brookings further confirmed the close correlation between stand and yield which had been previously reported.

The promising method of applying fungicides to the soil in addition to seed treatment was repeated. The materials Arasan and Carbon and Carbide experimental fungicide 670, which had produced significant increases in yield before, were applied to the soil at a rate of 4 pounds per acre. The fungicide in sand, as a carrier, was applied with the seed at the time of planting.

At both locations on medium plantings Arasan treated seed + Arasan in the soil produced higher yields and better stands than any material applied as a seed treatment. Although these higher yields were significantly better than the untreated check they were not significantly better than yields obtained by some seed treatments alone. On medium plantings Carbon and Carbide 670 added to the soil was similar to Arasan in its performance. On late plantings at Brookings the results of Arasan was similar to those for the medium planting but Carbon and Carbide 670 failed to increase yields significantly. At Highmore all materials failed to increase yields. All of the materials used increased yields significantly at least once, but no material was consistently outstanding.

A preliminary investigation was made of root rot resistance in 200 experimental sorghum lines. Fully mature plants were evaluated and at that time the amount of root damage among the lines ranged from 10 to 85 percent. An analysis of the data showed a significant

group, all but 19 were discarded either for susceptibility to scab or other undesirable qualities. The selected lines will be grown again in 1954.

Common scab is one of the more important diseases in South Dakota and can be, at times, a limiting factor in potato production. On the E. H. Lacey farm near Trent, South Dakota, a replicated experiment was designed to determine the influence of various broadcast applications of sulfur on the incidence of scab. While improvements in the method of application will probably give a more beneficial effect, a reduction of scab and increase in total salable tubers was obtained. (Project 107. Leader: A. A. Cook, Plant Pathology Dept.)

Root Rot Diseases of Small Grain

Experimental plots on root rot of wheat, including the testing of the newer fungicides for the control of seed rot and seedling blight, were not harvested because of the serious stem rust damage. The grain in the plots lodged prematurely and the kernels were largely hulls. Performance was to be determined mostly on the basis of yield differences and because of rust such differences were prevented. (Project 115. Leader: C. M. Nagel, Plant Pathology Dept.)

Septoria Leaf Spot Control on Tomatoes

Forty-odd successful tomato backcrosses were made in the greenhouse during the winter 1952-53 involving the isolation of disease resistant lines. The seed obtained was immediately planted and after 6 weeks, the plants were inoculated. Those lines which had proven resistant or segregating were transplanted into the field. Seed from individual plants in each line was collected during the summer and the resulting plants are now being further selected for resistance to Septoria leaf spot. (Project 146. Leader: A. A. Cook, Plant Pathology Dept.)

difference in the amount of root damage between lines.

Bacterial leaf spot and bacterial leaf stripe were prevalent on sorghum in 1953, especially in the experimental plots at Brookings. These diseases had destroyed as much as 75 percent of the foliage of sorghum by harvest time. However, infection of the experimental lines, under observation for root rot resistance, ranged from a trace to 75 percent. The various lines differed considerably in susceptibility to each disease, but from the standpoint of selection it is worthy of note that 26 lines had almost equal resistance to both diseases. In no case did infection exceed 20 percent and one-half of the lines showed only a trace of infection. Resistance in a selection to both of these common and potentially destructive bacterial leaf diseases is of considerable importance in developing adapted commercial varieties. Unfortunately no close correlation is apparent between root rot and leaf disease resistance in these lines. (Project 110, Leader: C. J. Mankin, Plant Pathology Dept.)

Corn Diseases and Their Control

Seven hundred and sixty-three lines of corn were developed during the past several years through selfing and selection for disease resistance. The principal disease problem being root rot and rust, bacterial spot, and the leaf blights.

Thirty-two representative selections from the above lines were grown in an experiment to study root rot damage. These 32 lines were dug with a tree digger which made it possible to remove a large amount of the root system from the soil. These corn plants were taken to the greenhouse where the soil was carefully washed from the roots. The roots of these plants were then carefully rated for root rot damage. The degree of root necrosis ranged from 10 percent on the root systems of some of the more disease-free lines up to 85 percent in others. This rather wide range in the amount of

root necrosis or rot damage on the roots of these 32 selected lines of corn indicated that some of these possessed a rather high degree of tolerance to root rot. Additional experiments in 1954 will be required to further substantiate the evidence obtained in 1953.

Approximately 40 selected lines will be grown in 1954 for top crossing to susceptible single-crosses to determine more as to their value in a breeding program in the production of disease resistant hybrids. This phase of the experiment will be conducted in cooperation with the Agronomy Department. (Project 185, Leader C. M. Nagel, Plant Pathology Dept.)

Foliage Diseases of Small Grains and Their Control

The results of attempts to control rust in the field by chemical sprays on Mida wheat, Brunker oats, Montcalm barley, and nine wheat varieties are reported on page 10 in the article "Rust—Is Chemical Control a Possibility?"

In cooperation with Dr. E. B. Lambert, Agricultural Research Service, United States Department of Agriculture, stem rust pustules of Race 56 were found to require 7 to 11 days to appear outdoors in late May or June on Ceres wheat leaves after the urediospores were dusted on seedlings, and incubated overnight in a moist chamber. The longer time was required during cooler periods.

Approximately 168 lines of wheat from the various state and Federal Experiment Stations were grown in the stem rust nursery. The principal objective was to determine whether or not certain of these lines possessed resistance to 15B stem rust. This is the new strain of rust to which all current commercial varieties are susceptible. In addition rust records were obtained on their reaction to scab, blackstem, and other diseases. The data obtained indicated that sources of rust resistance to 15B and the other diseases were present

in a number of these strains of wheat which could be used in a breeding program. Many of the wheat strains tested are not now of commercial quality but have values only in a breeding program. The estimated loss due to stem rust principally to wheat in South Dakota in 1953, amounted to \$43,000,000.

Several other small grain experiments were grown in cooperation with the USDA, such as the uniform stem and leaf rust nurseries involving barley, oats, and wheat. (Project 204. Leaders: George Semeniuk and C. M. Nagel, Plant Pathology Dept.)

Diseases of Alfalfa and Other Forage Legumes and Their Control

In the eastern part of South Dakota, blackstem as a leafspot disease was usually heavy in the first crop of alfalfa during 1953. This disease became destructive partly because the weather was favorable during late April, May, and June, and partly because the fungus was abundantly present on the alfalfa stubble left from the previous season. Also in the eastern part of the state, alfalfa rust was usually abundant, causing extensive defoliation in the late summer and fall cuttings. Other leafspot diseases present were caused by *Pseudopeziza medicaginis*, *P. jonesii* and *Cercospora zebrina*, which were in normal abundance. The occurrence of downy mildew (*Peronospora trifoliorum*) was sporadic and less common than in 1952.

In cooperation with the Agronomy Department, greenhouse inoculations with *Corynebacterium insidiosum*, *Ascochyta imperfecta* and *Cercospora zebrina* were made successively on clonal lines of first generation intercrosses between a number of parental lines of spreading alfalfa presumably possessing combined resistance to bacterial wilt (*Corynebacterium insidiosum*) and common leafspot (*Pseudopeziza medicaginis*). A number of clones proved resistant to *Ascochyta imperfecta* and

Cercospora zebrina. The response to *Corynebacterium insidiosum* had not been determined at the date of writing this report. Most of the progeny proved resistant to common leafspot diseases in the field but were moderately to extremely susceptible to rust. (Project 230. Leader: George Semeniuk, Plant Pathology Dept.)

The Quality of Grass and Alfalfa Silage As Affected by the Development of Specific Microorganisms

Alfalfa ensiled in open stacks, unless thoroughly packed or covered with plastic to exclude air, heated rapidly to temperatures as high as 153° F within a few days as a result of bacterial and mold action. The high temperatures continued for prolonged periods. The outer parts of the stacks, because of air accessibility, heated more readily to these higher temperatures, and rotted, than did the inner parts of the stacks.

The type of bacterial changes that occur in the outer parts of two open stacks are indicated in the table. The nonsporing aerobic and anerobic mesophilic bacteria increased rapidly at first and within approximately a week they were replaced largely by nonsporing thermophilic forms, principally aerobes. Thereafter, as the high temperatures continued, most of the bacteria died, and principally spore-forming aerobes remained.

The molds in the outer parts of the stacks were not identified as they could not be cultured. (Project 237. Leader: George Semeniuk, Plant Pathology Dept.)

The Biology and Control of Forage Grass Diseases

No extensive surveys were made of forage grass diseases throughout the state in 1953. Special attention was given to the bromegrass nursery and commercial fields at Brookings. In the nursery *Helminthosporium* leaf spot (*Helminthosporium bromi*), bacterial

Temperature and Kinds of Bacteria Present in the Outer Portions of
Two Ensiling Uncovered Stacks of Alfalfa

| | Fresh-cut Alfalfa | | Stack I | | | |
|--------------------------------------|----------------------|--------------------|--------------------|------------|---------|-----------|
| Days after stacking | 0 | 1 | 1 | 6 | 30 | 30 |
| Temperature of Silage Sample | | 98° F* | 131° F† | 149° F† | 131° F† | 131° F† |
| Aerobic Mesophiles Spore Formers | 0 | 709,000 | 205,000 | 3,200 | 110,000 | 1,100,000 |
| Aerobic Mesophiles Total | 640,000 | 25,900,000 | 4,100,000 | 3,000,000 | 250,000 | 1,000,000 |
| Aerobic Thermophiles Spore Formers | 0 | 1,300 | 8,900 | 77,500 | 40,000 | 0 |
| Aerobic Thermophiles Total | 0 | 1,850,000 | 800,000 | 21,000,000 | 100,000 | 0 |
| Anaerobic Mesophiles Spore Formers | 0 | spreading colonies | 2,200 | 90,400 | 60,000 | 45,000 |
| Anaerobic Mesophiles Total | 500,000 | 10,300,000 | spreading colonies | 15,000,000 | 0 | 0 |
| Anaerobic Thermophiles Spore Formers | 0 | 0 | 3,500 | 44,000 | 0 | 5,000 |
| Anaerobic Thermophiles Total | 0 | 0 | 150,000 | 5,650,000 | 0 | 0 |

| | Stack II | | | |
|--------------------------------------|------------|--------------------|---------|-----------|
| Days after stacking | 2 | 2 | 24 | 24 |
| Temperature of Silage Sample | 98° F* | 145° F† | 153° F† | 149° F* |
| Aerobic Mesophiles Spore Formers | 0 | 160,000 | 5,000 | 1,980,000 |
| Aerobic Mesophiles Total | 34,000,000 | 106,000,000 | 0 | 4,700,000 |
| Aerobic Thermophile Spore Formers | 0 | 256,000 | 0 | 30,000 |
| Aerobic Thermophiles Total | 0 | 350,000,000 | 200,000 | 0 |
| Anaerobic Mesophiles Spore Formers | 2,450 | 848,000 | 10,000 | 185,000 |
| Anaerobic Mesophiles Total | 26,400,000 | spreading colonies | 50,000 | 500,000 |
| Anaerobic Thermophiles Spore Formers | 50 | 570,000 | 0 | 0 |
| Anaerobic Thermophiles Total | 0 | 42,000,000 | 0 | 0 |

*About 3 inches beneath surface.

†About 1 foot beneath surface.

stripe (*Xanthomonas translucens*), Selenophoma leaf spots (*Selenophoma bromigena*) and ergot (*Claviceps purpurea*) were most prevalent, but in pastures and commercial fields only Helminthosporium leaf spot and bacterial streak were important.

The breeding selections and varieties of bromegrass in the nursery were evaluated for resistance to the prevalent diseases. Suitable techniques and methods were developed to further test the resistance of selected lines in the greenhouse.

Fungicidal seed treatments were used in a limited way at Brookings and Highmore in attempts to improve grass stands. Arasan, Carbon, and Carbide

experimental fungicides 670, 224, and C-O-C-S special C-1 were used to treat brome and Ree wheatgrass seeds. At Highmore Substation no improvement in stand of either brome or Ree wheatgrass was obtained by seed treatment. At Brookings no fungicide improved the stand of either grass, but stand counts taken 4 weeks after planting showed significant differences in the remaining stands of Ree wheatgrass. In plots treated with Carbon and Carbide 220 and C-O-C-S special C-1 the remaining stand was significantly better than the untreated check. In this case, at least, Carbon and Carbide 224 and C-O-C-S special C-1 appear to protect the

seedlings somewhat for at least 4 weeks after planting. (Project 250. Leader: C. J. Mankin, Plant Pathology Dept.)

Tree Diseases and Their Control

One of the important trees used in shelterbelt plantings in South Dakota and the North Central States is the cottonwood. Each year millions of these trees are planted. The cottonwood tree is considered one of the permanent species used in such plantings. During the past 20 years the mortality of the cottonwood in many of the shelterbelt and farmstead plantings has been serious, and because of these losses many farmers hesitated to plant them as commonly as they did during the 30's. Experimental evidence indicated that one of the major hazards responsible for these mortalities is the damage caused by leaf rust, which defoliates, weakens, and ultimately kills stands of cottonwood trees.

Pathological investigations resulted in the selection of a clonal line which is highly resistant to leaf rust. The tree is also highly resistant to "winter injury,"

is vigorous, and has a dense dark foliage. This selection also has the advantage in that it is a male tree and therefore does not produce "cotton," which heretofore has been an undesirable character in this species especially around the home or farmstead plantings.

The present increase is 150,000 and the anticipated increase is 650,000 trees by the fall of 1954. Release to growers is expected to be in April of 1955, provided their performance continues to be the same as in previous seasons of testing.

It is believed that with the introduction of this new leaf rust resistant cottonwood, it will re-establish this valuable tree as a prominent species in both shelterbelt and farmstead plantings.

Sixty-five new strains of populus were obtained in 1953 from the United States North Eastern Forest Experiment Station for testing at this Station for disease reaction. (Project 142. Leader: C. M. Nagel, Plant Pathology Dept.)

Rust—Is Chemical Control a Possibility? see page 10

Alfalfa Disease Problems in South Dakota, see page 26

Livestock Production

Development of a Tailless Breed of Sheep

Selections within the no-tail flock are being continued toward improving mutton and wool qualities while retaining the tailless character.

Taillessness appears to be a complex hereditary character. Because of this fact the character has not become fixed and the flock does not breed true. For example, of 83 lambs born in 1953, 57 or about 69 percent had 1 inch or less of tail at birth. The other 26 or 31 percent were about equally divided in tail lengths ranging from 2 to 6 inches. Two or three successive topcrosses using no-tail rams are required to naturally dock our common breeds of sheep.

Level of performance of the no-tail flock can be compared to other sheep by use of the following figures. Lambs born in 1953, both singles and twins, equalled the number of ewes bred. Lambs weaned at an average age of 112 days weighed 63 pounds. Following 66 days on feed, lambs were marketed at 85 pounds. The flock produced an average of 8.8 pounds of one-quarter to three-eighths blood fleeces.

Further selections are planned to improve lamb and wool production and to test the "breed" in crosses with others of our more common breeds of sheep. (Project 9. Leader: J. W. McCarty, Animal Husbandry Dept.)

Nutritive Value of Prairie Hay

In conjunction with experiments on the effect of time of harvest on the nutritive value of prairie hay, several tons of hay were stored each year for later tests on the feeding value after long time storage in the open. Feeding trials with this stored hay were conducted with calves at the Cottonwood, Eureka, and Highmore substations during the winter of 1953-54. At each substation, hay was fed that was harvested in 1948, 1950, 1951, and 1953. The 1953 hay was used to compare the value of the hays after various periods of storage with the current crop. One lot of 12 calves was fed each of the hays at each substation and enough soybean meal pellets to give about 10 percent protein in the total ration. They were fed all the hay that they would clean up without undue waste. Water, common salt, and a mixture of 3 parts bone meal and 1 part common salt were provided free access. The calves were fed their hay and pellets once daily.

There was some variation in rates of gain obtained with the various hays at each substation. In most cases the gains were less on the older hays. That harvested in 1948 and 1950 was rather brittle and resulted in a considerable amount of chaff and dust accumulating in the hay bunks. It was not consumed as readily as the 1953 hay and rates of gain were considerably less at two of the substations.

Digestion trials to determine the effect of dehydrated alfalfa meal and brewer's dried yeast upon the digestibility of good and poor quality prairie hay were completed at Brookings. Both ingredients appeared to be satisfactory in protein supplements, but they did not have any effect upon the digestibility of protein or organic matter in rations with either hay. (Project 120. Leaders: L. B. Embry and L. E. DuBose, Animal Husbandry Dept.; O. E. Olson, Station Biochemistry; and J. G. Ross, Agronomy Dept.)

Systems of Breeding Swine Project Herds Maintained at Brookings and North Central Substation, Eureka

Under study are several mating systems all subject to like selection procedures in order that the most efficient can be determined. Efficiency is measured in terms of sow productivity, pig vitality, and growth rate and carcass quality.

During the 1953 season five groups representing four mating systems were maintained at Brookings. These were inbreeding within the Poland China and Duroc breeds, outbreeding within the Poland China breed, rotational line crossing within the Poland breed, and rotational crossing of lines from the Poland China, Hampshire, Duroc, and Landrace breeds. As in six previous seasons the latter group proved most efficient for the production of slaughter hogs.

For 1954 all but the inbred Duroc line have been discontinued at Brookings. Inbred Hampshires formerly at Newell have also been added to the herd, and the Yorkshire breed is being sampled toward development of inbred lines. These three groups will be tested eventually in reciprocal crosses to determine their value in such crosses for efficient production.

At Eureka, breeding studies based on a Poland China inbred line have been discontinued. In their place a continuous crossing program which has included the Poland China line, formerly maintained at Eureka, will be carried. Sires for this program will be supplied from the inbred lines maintained at Brookings. (Project 124. Leaders: J. W. McCarty, Animal Husbandry Dept.; Albert Dittman, North Central Substation, Eureka.)

Swine Production for the Irrigated Area of Western South Dakota

Project objectives include improved swine breeding, feeding, and management in the irrigated area of western

South Dakota. Only the breeding phase is being pursued at present using a Hampshire inbred line.

Comparisons were possible the 1953 season between groups of litters all sired by inbred boars, but from both inbred and outbred sows. Inbred litters averaged 8.6 and 3.8 per litter at farrowing and at weaning, while litters from outbred sows averaged 8.2 farrowed and 6.8 weaned. Weaning weights were 31 and 36 pounds respectively for inbreds and topcrosses, and 147 and 176 at 154 days for the two respective groups.

Carcass measurements on both groups indicated similar kinds of high quality meaty carcasses.

For 1954 the Hampshires have moved to Brookings and have been replaced by a rotational crossbreeding program utilizing inbred lines of different breeds, among them the Hampshires developed at the Newell Station. (Project 132. Leaders: J. W. McCarty, Animal Husbandry Dept.; and Harry E. Weakly, U. S. Newell Field Station.)

Levels and Length of Time of Concentrate Feeding of Range Ewes

Four hundred permanently allotted range ewes aged 2 to 7 years were winter-grazed as a band. They were cut into four lots each day and fed 0.2 pound 40 percent, 0.2 pound 20 percent, or 0.4 pound 20 percent protein supplement from November 6, until lambing. The fourth lot was fed 0.2 pound of 40 percent protein supplement for the last 6 weeks of gestation only. The ewes were fed $2\frac{1}{2}$ pounds of native hay per head daily for 19 days because snow cover made grazing impracticable. They had free access to water, iodized salt, and a 1:1 salt-dicalcium phosphate mineral mixture. These ewes were pasture bred as a band from November 6 to December 19 and were shed lambed during April and early May.

Gains from November 6 to March 31 averaged 3.7, -1.0, and 7.0 pounds per

head for ewes fed 0.2 pound and 40 percent, 0.2 pound 20 percent, and 0.4 pound 20 percent respectively. The number of lambs born to these ewes expressed as a percentage of ewes lambing was 130.9, 130.8 and 136.5 respectively. Those ewes fed 0.2 pound 40 percent protein supplement for only the last 6 weeks of gestation lost 1.3 pounds per head during the period and the percent lambs born was 126.0. Shearing and weaning data will be collected. This study is being continued. (Project 159. Leaders: J. K. Lewis, G. T. King, L. B. Embry, Animal Husbandry Dept.; William R. Trevillyan, Antelope Range Field Station.)

Improvement of Beef Cattle Through Breeding

The objectives of this experiment are (1) the investigation of methods of selection for the improvement of beef cattle and (2) the investigation of the effects of inbreeding and the crosses of inbred lines. Progress the past year has been mainly in the field of correction factors for environmental differences between individuals. These correction or adjustment factors will enable breeders to compare more closely the breeding value of prospective replacements without the confusing effects of environment.

Analysis of the data to date indicate that the heritability of rate of gain in the feed lot is 32 percent. This analysis also showed that for each pound per day initial weight-for-age there was an increase of .27 pound per day in rate of gain. The regression of rate of gain on initial type score was -.01. The analysis of feed per hundred pounds of gain for the bulls on record of performance tests indicated that for each pound initial weight-for-age there was an increase of 66 pounds of feed per hundred pounds of gain, and for each grade increase in initial condition 15 more pounds of feed were required.

The bull and heifer calves that display their superiority in these performance tests are being saved for replacements in the breeding herds of the substations. These herds are carried under normal range conditions and selection is practiced on weaning weights and calving efficiency. (Project 167. Leaders: C. A. Dinkel, Animal Husbandry Dept; W. R. Trevillyan, Antelope Range Field Station; Wayne Gloe, Reed's Ranch; Frank Whetzal, Cottonwood Range Field Station.)

Comparisons of Pigs Farrowed at Different Seasons

The relative merits of farrowing pigs in early spring, late spring, summer or fall; the advantages of gilts or tried sows in the breeding herd, and a comparison of the one- and two-litter systems of farrowing were studied for the fifth year. This completes this project and a report is to be published in bulletin form soon.

A summary of the data for the 5-year period showed that pigs farrowed in early spring brought the highest prices when marketed but cost slightly more to produce than did late spring or summer pigs. Fall farrowed pigs brought an intermediate price but required about 75 to 100 pounds more feed per pig from weaning to market than did pigs farrowed in the spring or summer and fed on pasture during their growing period.

The use of gilts or tried sows offers little choice. The sows farrowed more pigs and their pigs were heavier at weaning time and reached market sooner. The gilts, however, required slightly less feed and the total costs were about equal.

The net return per hundred weight of pork produced was slightly greater for the two-litter system than for the one-litter system. The biggest advantage was from farrowing the first litter in the fall and the second litter in the spring,

then not only were the pigs marketed at high prices but the sows were also sold on a high market. (Project 168. Leader: R. C. Wahlstrom, Animal Husbandry Dept.)

Summer Grazing Studies with Sheep

Four hundred permanently allotted range ewes were bred as a band, fed during the winter on Project 159, shed lambed, and placed on fenced pastures from May 9 until November 6, 1953. The pasture treatments were light grazing season-long (0.87 acres per ewe per month), moderate grazing season-long or moderate grazing rotated weekly in a four unit rotation (0.68 acres per ewe per month) and heavy grazing season-long (0.42 acres per ewe per month).

Utilization at the end of the pasture season was estimated to be 10, 25, 25, and 50 percent respectively. This was a very favorable year since precipitation for 1953 was 15.98 inches of which 13.45 inches fell during the period from April 1 through September 30. There were no large differences in weight gains of the ewes, fleece weights, or lamb weaning weights. Apparently adequate forage was available under all treatments due to the unusually favorable precipitation.

This study is being continued. (Project 177. Leaders: J. K. Lewis, G. T. King, and L. B. Embry, Animal Husbandry Dept.; William R. Trevillyan, Antelope Range Field Station.)

Hormones in Fattening Lamb Production

Combination of stilbestrol and progesterone, and estradiol and progesterone in proportion of 1:25 were implanted subcutaneously in fattening lambs. A highly significant increase in rate of gain and feed efficiency was obtained by this treatment. However, in all trials completed, carcass grade and yield was lower in the treated lots. Further, maturity of the lambs was hastened and in

one lot 20 percent of the lambs failed to "break" and were sold as yearlings.

If hormone treatment is approved by the Pure Food and Drug Administration, the following suggestions will increase its effectiveness. (1) Lamb feeders should use it on lambs weighing 60 to 75 pounds as heavier lambs than that will likely be overweight before they are fat enough to sell as choice lambs. (2) Hormone treatment should only be used when lambs are on a full feed of a fattening ration. (3) Do not treat lambs with hormones that are not sold prior to April 1; otherwise the high incidence of the closure of the epiphysis joint will result in the lambs being graded as yearlings and will sell for considerably lower price. (Project 199. Leader: Robert M. Jordan, Animal Husbandry Dept.)

Feeder Lamb Responses to Aureomycin and Pelleted Feeds

Comparisons were made between lambs full-fed long alfalfa hay and shelled yellow corn (Lot 1) and pelleted alfalfa hay and corn (Lot 2). The lambs receiving the pelleted ration gained somewhat faster than those getting long alfalfa and corn. However, the grinding and pelleting cost \$7.00 per ton, and therefore the cost of the gain was more expensive in the lot receiving the pelleted ration.

When 10 milligrams of aureomycin were added to either a ration containing equal parts of alfalfa and corn, ground and pelleted, or a ration consisting of 75 percent alfalfa and 25 percent corn which was ground and pelleted, the rate of gain was increased .06 and .04 pound per head daily respectively. The lambs receiving aureomycin urinated considerably more than the control lambs and therefore bedding was a decided problem. The cost of the aureomycin fed to the lambs more than offset the additional rate of gain. Therefore the cost per hundred pounds of

gain for these lambs was greater than for the lambs which received the same ration without the aureomycin. (Project 206. Leader: Robert M. Jordan, Animal Husbandry Dept.)

Value of Creep Feeding Pigs

Five lots of eight sows and litters each were used in this study during the spring of 1954. In Lots 1, 2, and 3 the sows were hand-fed and the pigs had access to a creep ration. Pigs in Lots 4 and 5 did not receive any creep ration. The two lots differed in that the sows were self-fed in Lot 4 and hand-fed in Lot 5.

Lots 1 and 2 received the same creep ration except that it was pelleted for Lot 1 and fed as meal in Lot 2. This creep ration contained rolled oats, corn, sugar, soybean meal, meat scraps, fish meal, minerals, vitamins, and an antibiotic. The creep ration fed to the pigs in Lot 3 was the same ration as was fed to the sows except that it contained an antibiotic.

The creep ration fed in Lots 1 and 2 which contained a high amount of rolled oats (40 percent) and sugar (10 percent) was apparently very palatable and was consumed in about equal amounts regardless of whether in pellet or meal form. The pigs on this ration (Lots 1 and 2) gained about 0.1 pound per day faster than did those pigs in the other lots.

Pigs receiving the sow ration in a creep gained very little faster than did those which were able to eat with the sows at the self-feeder. The pigs in Lot 5 did equally as well as those in Lot 4. This was probably due to the fact that the sows, although hand-fed, consumed approximately as much feed as the sows which were self-fed in Lot 4. Hand-feeding a more limited ration may have altered these results. This experiment is being continued. (Project 212. Leader: R. C. Wahlstrom, Animal Husbandry Dept.)

Value of Antibiotic Combinations in Swine Rations

The effect of including various combinations of antibiotics in the protein supplement fed to growing-fattening pigs was studied in three trials. Four lots of from 10 to 15 weanling pigs each were used in each trial. Two of the trials were conducted under dry-lot conditions and one trial was with pigs on pasture.

The protein supplement was composed of equal parts of soybean meal and tankage on pasture and included 20 percent ground alfalfa in the dry-lot trials. The antibiotics were added at levels to supply 60 grams of antibiotic per ton of protein supplement in the first two trials and 80 grams in the third trial. In each trial there was one lot which did not receive any antibiotic and one lot which received aureomycin only. The other combinations tested were: aureomycin and penicillin, aureomycin and terramycin, and penicillin and streptomycin.

In all three trials the average rate of gain of the pigs receiving aureomycin was slightly over 6 percent faster than the average gain of those pigs not receiving any antibiotic. The combinations of aureomycin and penicillin and penicillin and streptomycin were equally as effective in increasing rate of gain as aureomycin alone. The combination

of aureomycin and terramycin did not cause any growth stimulation.

Feed efficiency was affected only slightly. The pigs receiving the combination of penicillin and streptomycin required the least feed per pound of gain. (Project 213. Leader: R. C. Wahlstrom, Animal Husbandry Dept.)

Summer Grazing of Beef Cows for Calf Production

Six pastures at the Cottonwood Range Field Station have been stocked heavily, moderately, or lightly from about May 1 to December 1 each year since 1942. These pastures were stocked with nine uniform grade Hereford 2-year-old heifers from May 14 through November 30, 1953, except that one animal was removed from one of the heavily-grazed pastures on September 7 in order to permit the remaining animals to complete the season.

The results are shown in the table. Gains per acre were higher for the heavily stocked pastures, whereas gains per head were higher for the more lightly stocked pastures. These heifers were bred on pasture and will return to the same pastures each year for the duration of the study. (Project 216. Leaders: J. K. Lewis, Animal Husbandry Dept.; O. E. Olson, Station Biochemistry; and Frank Whetzel, Cottonwood Range Field Station.)

Summer Grazing of Beef Cows for Calf Production, May 14 Through November 30, 1953*

| | Heavy | Moderate | Light |
|---|-------|----------|-------|
| Acres grazed | 160 | 266 | 366 |
| Stocking rate, acres/AUM | 1.7† | 2.69 | 3.66 |
| Utilization (visual estimate), percent | 65 | 48 | 22 |
| Range condition, percent‡ | 36 | 67 | 79 |
| Number of heifers (2-year-old)‡ | 17 | 18 | 18 |
| Total gain per heifer (calculated), lbs.§ | 158.5 | 169.4 | 225.7 |
| Total gain per acre (calculated), lbs.§ | 16.8 | 11.5 | 10.8 |

*Annual precipitation for 1953 was 18.5½ inches and growing season precipitation (April 1—September 30) was 11.00 inches compared with the long time average of 14.72 inches and 11.77 inches respectively.

†Range condition was estimated by Leslie R. Albee, Soil Conservation Service.

‡One heifer was removed from a heavily grazed pasture on September 7 to allow the remaining animals to complete the season.

§These gains include the gains of calves from 2 heifers under heavy grazing and 3 heifers under moderate grazing which were accidentally bred. It also includes the calculated gain for the AUMs of grazing furnished by the heavily-grazed pasture to the animal which was removed on September 7.

Vitamin A Supplement for Range Cows

Fifty-four permanently allotted, grade 2-year-old Hereford heifers were winter-grazed in six comparable deferred winter pastures in excellent condition. They were fed 1 pound per head daily of a 38 percent protein supplement containing added phosphorus and 0, 8,000, or 24,000 USP units of vitamin A. The experiment was conducted from November 30, 1953 through April 20, 1954. The cattle were rotated from pasture to pasture each week to compensate for pasture differences. Prairie hay cut after frost in 1952 was fed for 3 days because of snow cover.

There were no large differences in weight gains between treatments. Blood samples were taken on November 30, January 18, and March 18 and analyzed for plasma vitamin A, carotene, and phosphorus. Differences due to treatment were small. Plasma vitamin A and carotene remained well above borderline values for all 3 samplings. Plasma vitamin A was highest in all lots at the January 18 bleeding. Liver storage was estimated in March by measuring the increase in plasma vitamin A produced by drenching the cattle with 47.5 cc of absolute ethyl alcohol per hundred pounds body weight. All animals, irrespective of treatment appeared to have considerable storage.

Calf production is being recorded. This study is being continued with the same animals on the same treatments. (Project 217. Leaders: J. K. Lewis Animal Husbandry Department; O. E. Olson and A. Halverson, Station Biochemistry; Frank Whetzal, Cottonwood Range Field Station.)

Manganese Requirements of Growing-Fattening Cattle

Manganese requirements of cattle are commonly given at levels where a deficiency would be likely with many natural feeds. However, no clear-cut

manganese deficiency has been reported in cattle. Therefore, an experiment was conducted during the summer of 1953 to determine the manganese requirements of growing-fattening yearling steers. A low manganese basal ration of the following composition was fed: ground shelled yellow corn, 56.0; ground corn cobs, 30.0; dried buttermilk, 11.8; urea 1.0; salt with cobalt and copper, 0.5; bone meal, 0.3; and ground limestone, 0.4.

The basal ration was mixed in 2-ton lots as needed and contained from 8.7 to 5.5 parts per million (p.p.m.) manganese. The rations contained about 14 percent protein, 1.0 percent calcium and 0.60 percent phosphorus. Three groups of four steers each were individually fed as follows: basal, basal plus manganese sulfate to give about 40 p.p.m. of manganese, and basal plus manganese sulfate to give about 400 p.p.m. of manganese. All steers were fed slightly more than they would consume at each feeding. They were fed in dry-lot with broken corn cobs used for bedding. The cobs contained 10.6 p.p.m. of manganese but very little consumption of the bedding was noted.

During the first 85 days of the trial, the average daily gains were 2.10, 2.07 and 2.14 pounds, respectively, for the basal, 40, and 400 p.p.m. of manganese. The steers were fed for another 80 days and the average daily gains were 2.02, 2.18, and 1.65 pounds, respectively, for the three levels of manganese during this period. The rations with the low and medium levels of manganese became contaminated at one mixing during this last period so there was no longer a test of the effects of the low level of manganese. This last phase is included to show the effects of long time feeding of the high level of manganese.

The results indicate that 400 p.p.m. of manganese depresses growth of yearling steers. Additional work is planned to determine the minimum manganese

requirements of cattle in which weaned calves will be fed for approximately 1 year. (Project 218. Leaders: L. B. Embry, Animal Husbandry Dept.; O. E. Olson, Station Biochemistry.)

A Supervised Pasture System

The value of different types of grasses and legumes as pasture is being studied at the Brookings Station. The study was initiated in 1953 and has completed only one full grazing season. The types of pastures being studied are brome-grass, alfalfa-brome mixture and sweet clover-rye mixture; two 8-acre pastures of each type. Yearling Hereford steers are grazed at a rate compatible with the available forage, and weights are taken on the steers to ascertain total gain per acre and average daily gain per animal.

Figures from the 1953 season show that the brome pastures produced 3,398 pounds of beef in 1,742 days for an average daily gain of 1.95 pounds per head and an average of 212 pounds of beef per acre. The alfalfa-brome produced 5,511 pounds of beef in 2,900 animal days for an average daily gain of 1.90 pounds per head and an average of 345 pounds of beef per acre. The sweet clover-rye produced 3,802 pounds of beef in 1,996 animal days for an average daily gain of 1.90 pounds per head and an average of 238 pounds of beef per acre.

Considerable bloat was experienced in the alfalfa-brome pastures and resulted in the loss of eight steers. This may be due to grazing the pasture the first season before the brome had established a stand. The brome pastures were stocked at a low rate because they had not established a good stand, and the season had to be shortened on the clover due to dry weather and weevil infestation.

Since some unavoidable problems were encountered and due to the fact that only one year's data are available, no conclusions can be drawn. The pro-

ject is being continued this season with some variation in pastures and in management practices. (Project 225. Leaders: W. W. Worzella, Agronomy Dept.; F. W. Crandall, Animal Husbandry Dept.)

Irrigated Pastures in Western South Dakota

Cattle and sheep are being pastured on irrigated alfalfa-brome to determine rate of gain, carrying capacity, and effect of livestock on the longevity of the alfalfa-brome stand. The pasture carried approximately 1.5 steers per acre and 7.2 mature sheep per acre. The average gain made per steer during the pasture season in 1953 was 216 pounds or an average daily gain of 2.03 pounds. Beef production per acre was approximately 300 pounds.

The total sheep gain was not as great because the ewes were fat when put on pasture and made little gain in weight. The lambs weighed 56 pounds at the start of the experiment and therefore a good deal of their gain had already been made and was not credited to the pasture. In spite of these two handicaps, sheep production per acre was about 200 pounds.

The steers that were on pasture consumed 4 to 6 pounds of hay per head daily. The sheep, on the other hand, consumed very little (.25 pound per head daily).

Bloat is one of the serious problems in pasturing irrigated alfalfa and brome. One steer died from bloat during the 1953 season. (Project 229. Leaders: Robert M. Jordan, James K. Lewis, Animal Husbandry Dept.; W. W. Worzella, Agronomy Dept.; and Harry Weakly, U. S. Newell Field Station.)

Feeder Lamb Responses to Bentonite

Four trials were conducted during the past year to determine the effect of adding bentonite to lamb fattening rations. There was no significant effect

from adding bentonite to the rations. Neither did the addition of bentonite adversely affect the lambs. In two trials, the carcass yield of bentonite-fed lambs was 3 to 4 percent greater than the controls. A comparatively coarse type of bentonite was used in this year's trial and this may account partly for the inconsistency with the first year's results.

Molasses was added to lamb fattening rations and in all four instances, an increase in gain resulted. However, feed efficiency was not improved and the cost of the molasses more than offset the advantage in the additional rate of gain. (Project 233. Leaders: Robert M. Jordan, Animal Husbandry Dept.; Harry Weakly, U. S. Newell Field Station.)

Effect of Alfalfa Silage When Fed to Pregnant Ewes

Two lots of 20 ewes each were experimentally fed to determine the relative value of alfalfa silage and alfalfa hay as a roughage for wintering pregnant ewes. The two lots were fed so that approximately the same amount of dry matter was received by each ewe in each lot.

The ewes fed alfalfa hay gained 32.8 pounds during a 126-day feeding period while the ewes fed alfalfa silage gained 14 pounds during the same period. There was only one ewe that failed to lamb in the group fed alfalfa hay and five in the group fed alfalfa silage. The alfalfa-hay-fed ewes had a 165 percent lamb crop and sheared on the average 11.5 pounds of wool and the alfalfa-silage-fed ewes had a 130 percent lamb crop and sheared 9.6 pounds of wool. Approximately two-thirds of the silage harvested was lost as feed for one reason or another. (Project 237. Leader: R. M. Jordan, Animal Husbandry Dept.)

Alfalfa Silage for Fattening Cattle

An experiment was conducted to evaluate different methods of storing

alfalfa as silage or hay when it is to be utilized as a beef cattle feed. A first cutting crop of alfalfa was swathed and allowed to wilt; then a field chopper was used in cutting and blowing the alfalfa into trucks. Silage was made under three different storage plans with approximately 35 tons being stored in each plan. No preservative was used in any of the silage.

Places of storage were an upright cement stave silo, a pile on the ground, and a trench silo. Another supply of feed was stored in the form of alfalfa hay baled from the same field as was the source of silage placed in the upright silo. Weight records were kept on all methods of storage in order that losses from the time of initial storage through the feeding period could be measured.

Forty long yearling Hereford steers divided into four lots of 10 each were started on feed in October. The intention was to produce enough gain on these steers that they could be sold at slaughter grades of good or choice. Each lot received the same amount of cracked shelled corn daily. They were started at the rate of 3 pounds per head daily and increased until all were getting 7 pounds per day.

Percentage of feed stored which was actually weighed out and fed was 59 percent for alfalfa silage in upright silo, 44 for alfalfa silage in pile, 37 for alfalfa silage in trench, and 86 for alfalfa hay in bales. More work is planned to evaluate different methods of storing alfalfa as a feed for beef cattle. (Project 237. Leader: W. C. McCone, Animal Husbandry Dept.)

Effect of Penicillin, B-Vitamins and Level of Protein on the Growth of Pigs

A total of 128 weanling pigs were used in two experiments this past year to study the effect of penicillin and B-vitamins on the growth of pigs fed different levels of protein. A mixed basal ration of corn, soybean meal, tank-

age, and minerals was fed in dry lot in both trials. The protein levels studied were 18, 16, 14, and 12 percent from weaning to 100 pounds live weight, and 14, 12, 10, and 9 percent from 100 to 200 pounds.

Penicillin at 5 milligrams per pound of ration and/or B-vitamin supplementation (riboflavin, niacin, pantothenic acid, vitamin B₁₂ and choline) had a highly significant effect in improving rate of gain. This response was shown at all levels of protein fed.

The 10 percent protein ration appeared to be limited in one or more of the five B-vitamins fed more than in amount or quality of protein when fed to pigs over 100 pounds in weight. A 12 percent protein ration from weaning to 100 pounds or 9 percent protein ration from 100 pounds to market weight did not support normal growth even when the rations contained the penicillin and B-vitamin additions.

Leaner carcasses were produced by pigs receiving the B-vitamin supplementation or the 18 to 14 and 16 to 12 percent protein rations as compared to those getting no added B-vitamins or the low protein rations respectively. The results suggest the 16 to 12 percent protein combination would be preferred from an over-all economic viewpoint considering rate of gain, feed efficiency and carcass quality. (Project 238. Leader: R. C. Wahlstrom, Animal Husbandry Dept.)

The Tryptophan Requirement of Pigs

The effect of additions of small amounts of DL-tryptophan to a 12 percent protein corn-soybean meal ration is being studied. Forty-eight weanling pigs are being used in this experiment. They were divided into 12 lots and fed on six different levels of tryptophan (2 lots per treatment). No data are available at this time. (Project 251. Leader: R. C. Wahlstrom, Animal Husbandry Dept.)

Protein Supplements for Sheep Include Whole Soybeans for Fattening Lambs and Salt-protein Mixtures as a Means of Limiting Protein Intake

Two lamb feeding trials have demonstrated that whole soybeans can advantageously be fed to fattening lambs. Rate of gain and feed efficiency are equal or greater when whole soybeans are fed to fattening lambs than when soybean oil meal is fed as the protein supplement. The most striking finding of the trials was that the carcass grade and yield of the lambs fed whole soybeans were superior to the lambs fed soybean oil meal as a protein supplement. Whole soybeans offer farmers in the eastern part of the state an opportunity to lower their protein supplement costs.

A mixture of one part salt and two parts of soybean oil meal can be self-fed to either fattening lambs or pregnant ewes without adversely affecting lamb production. This mixture will limit the protein intake to about .2 of a pound per head daily. The practice will reduce labor and equipment costs and will be particularly applicable when one is lambing-off corn fields. (Project 248. Leader: Robert M. Jordan, Animal Husbandry Dept.)

Alfalfa Hay, Alfalfa Silage, and Corn Silage for Fattening Lambs

The results of this work are report in Circular 106 dated April 1954. (Project 223. Leader: R. M. Jordan, Animal Husbandry Dept.)

Artificial Milk for Baby Pigs see page 1

Hulless Oats for Fattening Lambs, see page 46

Effects of Antibiotics on Pork Carcasses, see page 71

Norghum Sorghum for Growing-Fattening Pigs, see page 95

Dairy Production

Growth Studies of Calves and Growing Heifers

The birth weight and growth rate of dairy heifers in the South Dakota State College herd is being measured. This involves measuring the rate of growth from birth to maturity for females in the Holstein, Brown Swiss, Guernsey, and Jersey breeds. Very little information of this nature is available for dairy cattle in the North Central States. It is possible that it may be advisable in the future to breed heifers for their first pregnancy when they reach a certain size rather than to wait for them to attain a certain age as is now done by most dairymen. It will require a number of years to get the information sought in this study. (Project 153. Leader: Chase Wilson, Dairy Husbandry Dept.)

Milking Machine Sanitation

Work has been continued, during the past year, on the use of flush type cleaning of the combine milker at the College dairy farm. Several cleaning materials have been compared for the relative efficiency of cleaning; namely, an acid cleaner, a balanced alkali cleaner, and an alternate cleaning procedure making use of both an acid cleaner and a strong alkali. A comparison was made between a liquid chlorine compound having an alkaline reaction and a powdered chlorine compound with an acid reaction. The bacteriological data were obtained by using rinse counts and swab counts on the milking equipment immediately before milking.

The results showed that the alternate use of an acid cleaner and a strong alkali cleaner gave the best results in cleaning this equipment. The use of the acid cleaner alone and the mild alkali alone was not as effective as the alternate cleaning procedure. There appeared to be a definite advantage shown for the

powdered chlorine compound over the liquid chlorine compound in reducing the bacterial counts in the equipment. However, the powdered chlorine compound has the disadvantage that it is more expensive and less stable than the liquid product. (Project 155. Leader: R. J. Baker, Dairy Husbandry Dept.)

Manufacturing Cottage Cheese

Methods of improving cottage cheese quality by altering manufacturing procedures are being studied. The addition of solids from dried milk-solids-not-fat to the fresh skim milk has been followed routinely. This practice not only yields a firmer curd at cutting time, but also increases the yield of the cheese.

A comparison of various coagulating agents has been made, showing little advantage for any particular coagulant. Trouble was again experienced with poor cheese at certain times of the year which indicates the necessity for more knowledge about seasonal chemical variations of the milk. (Project 169. Leader: R. J. Baker, Dairy Husbandry Dept.)

The Improvement of Dairy Cattle Through Breeding

The South Dakota State College Holstein herd is being used in the long-time phase of this study. Two inbred family lines are being developed. These are "Rag Apple" and "Wisconsin Admiral Burke Lad" breeding. Both families will be intensified to an inbreeding coefficient of about 30 percent and then maintained at that level. Each family will make up one-third of the herd. The remaining one-third of the herd will be used to cross the two inbred families in a criss-cross pattern.

This plan of mating is being followed to test for possible hybrid vigor within a purebred breed. If it proves to be of value, this system of breeding would

permit a breeder to benefit from hybrid vigor and at the same time retain the identity of the purebred parents in the offspring.

A study involving Brown Swiss cattle showed a positive correlation to exist between their type (body conformation) and their milk and butterfat production for both individual yearly lactations and with their total lifetime production. The correlation for the latter was rather high. (Project 184. Leader: Chase Wilson, Dairy Husbandry Dept.)

A Study of the Recovery and Transplantation of the Bovine Ova

The investigations this year on ova transfer have dealt with three phases: (1) The use of 50 milligrams of progesterone to regulate the heat cycle, has given satisfactory results in that a cow injected 14 days post estrus will be in heat 4 days after injections are stopped. (2) The ability to relax the cervix with relaxin enough for instrumental manipulation inside the uterus has been disappointing. With the levels of relaxin thus far used, the cervix has not been dilated beyond 1.6 inches. (3) Ova from slaughtered animals have been transferred by non-surgical techniques. Whether or not such a technique will be satisfactory remains to be proven. These ova were transferred in blood serum inside a gelatin capsule through a cannula into the body of the uterus.

If the proper amount of relaxin or the proper combination of relaxin and other hormones can be found, then possibly the cervix can be dilated nearly to the size obtained at parturition. This would allow the use of instruments within the uterus for ova recovery. (Project 189. Leader: A. E. Dracy, Dairy Husbandry Dept.)

Improved Pastures for Dairy Cattle

All available acreage in the College dairy farm is being seeded to a mixture of bromegrass and alfalfa. This will

permit the testing and demonstration of proper methods of strip grazing as compared to uncontrolled "free-range" grazing. The practicability of cutting and chopping the fresh forage daily and feeding it in the dry lot as compared to grazing is also under consideration. Other pasture management problems of practical application will also be studied. (Project 234. Leader: Chase Wilson, Dairy Husbandry Dept.)

A Study of Some Physiological Factors That May Cause Bloat

During the summer of 1953 and throughout the winter of 1954, a number of physiological factors that might cause bloat were investigated. Among the more notable of these were: the ligating of the esophagus to prevent the escape of gas by eructation, the sectioning of the vagus nerve to prevent rumination, and the effect of drenching sheep with legume juice.

The accumulation of gas within the rumen resulting from fermentation usually is accredited with the cause of death resulting from the condition known as bloat. Since fermentation is continuous, the accumulation of gas should also be continuous within the rumen providing the escape by eructation should be interrupted. This series of experiments was devised so that the escape of gas was prevented and had to remain in the rumen for a 5-hour period. To ligate the esophagus, the neck region of the sheep was anesthetized with 2 percent procaine. The esophagus was exteriorized and clamped with the hemostat so that no gas could be eliminated by eructation. During this experimental period, no sheep died as a result of gas accumulating from normal fermentation. Since none of these animals showed signs of bloat prior to ligating the esophagus, possibly some other substance is present that does the killing other than the accumulation of gas.

Another series of experiments to determine the effect of gas accumulation

within the rumen was accomplished by sectioning the vagus nerve. When the vagus nerve is cut, rumen motility ceases and the animal is unable to eructate. When eructation is inhibited, gas accumulation within the rumen can proceed uninhibited. On two sheep that had been allowed to eat all the legume pasture they wished for a 24-hour period, the nerves were cut and they did not die during the next 24-hour period. This, too, is further evidence that gas alone is not the cause of death resulting from bloat.

Because bloat usually results among ruminants pastured on legumes, a number of animals were drenched with legume juices. Of the sheep drenched, with as much as 1700 cc. of alfalfa juice, none showed severe signs of bloat. Although none of these animals bloated, the possibility needs re-investigation due possibly

to not enough juice or not the proper time of year. Therefore, under the condition of this experiment, the legume juices did not induce bloat. (Project 245. Leader: Arthur E. Dracy, Dairy Husbandry Dept.)

Feeding Dairy Steers for Beef

Holstein bull calves are now being fed to determine the profitableness of feeding them for beef production. Some are being fed for veal production as a possible outlet for surplus milk. Others are being fed to different ages to determine which is the most efficient and profitable time and age to market surplus dairy bull calves. (Project 249. Leader: Chase Wilson, Dairy Husbandry Dept.)

Alfalfa Silage Versus Alfalfa Hay,
see page 4

Poultry Production

Control of Selenium Poisoning in Poultry

This project has been concerned with the exploration for materials that could be used to counteract the toxic effects of selenium upon young chicks. Sodium arsenite or arsanilic acid were again found to be about equally effective in partially counteracting the toxic effects. Additional data were obtained to show that there is a differential tolerance to selenium poisoning and response to arsenical treatment with respect to the type of chicks used. Procaine penicillin at 4 grams per ton gave a greater growth response on toxic diets than on control diets, especially with female chicks, indicating that it, too may help alleviate selenium poisoning. Linseed meal has also shown some promise when added at the 5 percent level along with arsanilic acid at 180 grams per ton. (Project 28. Leaders: C. W. Carlson and Wm. Kohlmeyer, Poultry Dept.; O. E. Olson, Station Biochemistry.)

Forage Crops for Turkeys

Alternate strip planting of corn and rape in rows provided a very satisfactory range for growing turkeys. The rape provided early and late green forage and the corn provided shade and wind protection as well as grain late in the season. The turkeys would not eat the corn until it had been broken down.

Turkeys in a control pen with oats and rape sown together grew just as rapidly as those in the corn and rape pen, but there was less forage available. The turkeys on this forage crop required approximately 7 percent more feed. (Project 79. Leaders: Wm. Kohlmeyer and C. W. Carlson, Poultry Dept.; Albert Dittman, North Central Substation, Eureka.)

Increased Size of Laying Flocks Affects Egg Marketing

Experience has shown that egg quality and egg marketing practices are likely to improve as flock size increases.

The period from 1940 to 1950 showed a reduction in the number of South Dakota farms and ranches reporting chickens on hand from nearly 64,000 to 54,000. The production of eggs, however, increased by nearly 50 percent over this same period, while the total numbers of chickens on hand increased from about 6 million to 7 million.

In 1940 about 45 percent of the state's total production of eggs came from flocks of 100 to 200 hens, and an additional 25 percent from flocks of 200 to 400 hens. By 1951 the 100 to 200 hen flocks were producing only about 35 percent of the eggs, and flocks of 200 to 400 hens accounted for about 42 percent of the total egg production. Indications are that this trend towards fewer, but larger, flocks has continued at an accelerated pace since 1951. It appears that this sweeping change is occurring more rapidly in South Dakota than in most other Midwest States.

The net effect of this change should be the production and marketing of more high quality eggs by South Dakota producers. To the extent that these better eggs are sold on a discriminating market, the average price of eggs may be expected to show a relative increase. (Project 175. Leaders: Wm. Kohlmeier, Poultry Dept.; Ernest Feder, Agricultural Economics Dept.)

Performance Tests with Poultry

In one performance test this year, a pen of experimental hybrids has been compared with a pen each of single comb (S.C.) White Leghorns, commercial hybrids, and crossbreds (New Hampshire X White Leghorns). Mortality has been high in the latter three groups whereas it has been low in the experimental hybrids, although all birds were reared together and are housed in adjoining pens. The experimental hybrids have also been consistently superior in egg production when compared with the other three groups. The egg

size of the experimental hybrids and commercial hybrids was below that of the crossbreds or Leghorns.

In another test the progeny of single cross males (Inbred White Plymouth Rock X Inbred Rhode Island Reds) mated to outbred White Plymouth Rocks and also New Hampshires were compared with progeny of the reciprocal single cross males (Inbred Rhode Island Red X Inbred White Plymouth Rock) mated to outbred New Hampshires. A pen of crossbreds (Barred Plymouth Rock X White Plymouth Rocks) serve as a standard of comparison. Differences between the groups are small with all groups having good livability, production, and egg size.

In a third test, the performance of a single cross top cross (Inbred White Plymouth Rocks X Inbred Rhode Island Reds) X Barred Plymouth Rocks) has been compared with that of a crossbred (S. C. White Leghorn X New Hampshires) and an experimental hybrid with a pen of New Hampshires serving as a control. Mortality has been high for all groups. Production of the purebred New Hampshires is considerably lower than that of the other three groups, but their egg size is larger than in the experimental hybrids or crossbreds while smaller than that of the single cross topcross. The crossbreds have laid slightly better than the single cross topcross thus far, and both groups have exceeded the performance of the experimental hybrid both in egg numbers and egg size.

In summary, this year's results tend to confirm those of previous years when it has been demonstrated that crosses tended to be superior to purebreds. Furthermore, inbreeding plus subsequent crossing has tended to give results superior to those obtained by crossing without previous inbreeding. As might be expected, there are exceptions to this generalization. (Project 194. Leaders: D. G. Jones, Wm. Kohlmeier, Poultry Dept.)

Phosphorus Requirements of Turkeys

Early work involved the use of a purified diet which did not contain unidentified nutrients as shown by comparison with a practical diet. Additions of small percentages of forage juice, dried buttermilk, and dried brewer's yeast to the purified diet greatly improved the growth of poults. Addition of ascorbic acid was of no advantage.

Addition of dried buttermilk and of dried brewer's yeast also improved the growth of poults fed a practical diet, while forage juice was of no benefit. The addition of 4 percent bentonite reduced poult growth.

The purified diet supplemented with forage juice, dried buttermilk, and dried brewer's yeast compared favorably with a practical diet when fed to poults. This supplemented purified diet was used in evaluating the availability of phosphorus in commercially available phosphate supplements. Body weights, mortality, and tibia bone ash percentages of poults grown to 4 weeks of age were used to rate the supplements as shown in the table. This provided a severe test for the supplements because the phosphorus needed by the poults had to come almost entirely from the phosphate supplement while in the case of practical diets, the ingredients contain appreciable amounts of phosphorus.

Tests are underway to determine whether this rating of availability will be applicable when a practical diet is used. (Project 221. Leaders: R. A. Wilcox, C. W. Carlson, and Wm. Kohlmeier, Poultry Dept.; G. F. Gastler, Station Biochemistry.)

Factors Affecting the Performance of Turkeys

Growth trials with poults up to 4 weeks of age have shown the necessity of using the antibiotics and animal protein supplements for maximum growth rate. In a trial conducted with growing turkeys on range to 28 weeks of age, it was also shown that the anti-

Rating of Phosphates When Supplementing a Purified Diet With Respect to Body Weights, Mortality and Tibia Bone Ash Values of 4-week Old Beltsville Small White Poults

| | |
|--------------------------------------|-----|
| Dibasic calcium phosphate USP XIV* | 100 |
| Defluorinated phosphate B | 101 |
| Monobasic calcium phosphate | 97 |
| Defluorinated phosphate C | 94 |
| Defluorinated phosphate A | 75 |
| Steamed bone meal | 75 |
| Tribasic calcium phosphate NF IX | 73 |
| Commercial dicalcium phosphate No. 2 | 66 |
| Commercial dicalcium phosphate No. 1 | 63 |
| Beta tricalcium phosphate | 60 |
| Imported rock phosphate A | 0 |
| Imported rock phosphate B | 0 |
| Colloidal phosphate No. 1 | 0 |
| Colloidal phosphate No. 2 | 0 |
| Colloidal phosphate No. 3 | 0 |

*Values for dibasic calcium phosphate USP XIV arbitrarily set equal to 100 and the other supplements rated in comparison to it.

biotics were required even after 12 weeks of age for maximum growth rate. Feed efficiency was not affected by the antibiotics in this latter work. Also a comparison of oats and corn as the major cereal constituent of the diet was made in this study. Growth rate of the hens did not differ, whereas the toms grew more rapidly on the corn diets. Feed efficiency was approximately 20 percent better with corn in the diet.

Confirmation of the necessity for having supplemental vitamin B₁₂ in a corn-soybean type diet for breeder hens has been obtained. Greater hatchability of fertile eggs was obtained with the addition of vitamin B₁₂ to the diet, whereas the influence of aureomycin was not consistent. It appears that an unknown factor may be required. Male progeny from hens receiving diets containing aureomycin or forage juice showed more rapid growth than controls under certain conditions. (Project 242. Leaders: C. W. Carlson, D. G. Jones, and Wm. Kohlmeier, Poultry Dept.; O. E. Olson, Station Biochemistry.)

An Improved White Plymouth Rock—South Dakota 101, see page 34

Breed, Diet, Sex, Affect Growth Response of Chicks to Antibiotics, see page 88

Livestock and Poultry Diseases and Parasites

Sheep Parasite Control

The 1953 grazing season, with greater rainfall, provided more favorable conditions for the build-up of worm infestations in the sheep at the Antelope Range Field Station than was the case in 1951 and 1952. The levels of worm infestations in each of four pastures were determined on June 2, July 14, August 4, and September 1 by counts of the parasite ova in individual fecal samples from 12 percent of the ewes and lambs. Grazing levels were maintained in the pastures as in previous years to provide (1) light, (2) moderate, (3) heavy, and (4) rotational grazing at a moderate level.

The first samples from the ewes averaged 1067, 1856, 1161, and 1180 worm eggs per gram of feces for the four lots respectively. There was a sharp reduction in all groups by the July 14 sampling and ewe counts remained low for the remainder of the season.

Worm eggs had not yet appeared in the lamb samples on June 2. The high for the season with averages of 1131, 1063, 1941, and 1480 eggs per gram was recorded August 4. The eggs were predominately those of the common stomach worm, *Haemonchus contortus*. The build-up in the lambs was from 3.6 to 5.6 times greater than in 1952 at the different grazing levels, but no definite clinical signs of parasitism appeared. At one or more samplings, tapeworm eggs were found in 45 of the 51 lambs, included in the studies.

There were some wide differences in seasonal gains made by the individual lambs but the more highly parasitized lambs did not necessarily show the poorer gains. (Project 139. Leader: G. S. Harshfield, Veterinary Dept.)

Respiratory Diseases of Poultry

Newcastle disease is only one of several infectious diseases of poultry that

produces respiratory symptoms. Infectious bronchitis, chronic respiratory disease (CRD), coryza, or at times chronic fowl cholera will produce "colds" in chickens and it is often difficult to arrive at a definite diagnosis without specific laboratory tests. The incidence of Newcastle disease has not increased in this area over the past 2 years, but infectious bronchitis has become quite prevalent in both chicks and mature birds during this period.

A survey was conducted during a 5-month period from September 1953 to February 1954 to determine the incidence of infectious bronchitis among poultry flocks. Using serum neutralization tests of blood samples, 34 of 100 flocks were determined to be either undergoing an outbreak or to have been exposed to the virus of bronchitis sometime prior to the test.

Infectious bronchitis may cause serious death losses in outbreaks among chicks. In laying flocks, the death rate is usually low but production is markedly affected for periods of 2 to 3 months. (Project 170. Leader: G. S. Harshfield, Veterinary Dept.)

Fowl Cholera

The investigation of the use of antibiotic preparations, in treating flocks with fowl cholera, was continued this past year. Preliminary trials indicated that preparations containing terramycin were quite effective in controlling experimental fowl cholera.

It was found that similar preparations containing aureomycin were also effective against *Pasteurella multocida*, the fowl cholera organism. However, under the conditions of one experiment, when compared to terramycin, it was found that one-half the experimental dose of terramycin was equally effective as the full experimental dose of aureomycin.

A preparation containing terramycin, for use in the drinking water, was compared with a similar preparation for use in the mash. The results of the experiment were difficult to evaluate, as the chickens receiving the treated drinking water were reluctant to drink, particularly, shortly after they were exposed to the fowl cholera organism. Though the response was better in the birds receiving the treated mash, the birds receiving terramycin in the drinking water did benefit from the treatment.

A simulated field outbreak of fowl cholera was established in an experimental flock of birds, to determine the value of terramycin as it might be used in the field, but under controlled conditions. The outbreak was started in a flock of pullets that had begun to lay. The flock was then divided into two, nearly equal groups by partitioning the pen. One group was given terramycin treated mash; the other group given untreated mash served as the control. The mortality rate in the group of birds receiving the terramycin treated mash was 12 percent, as compared to 80 percent in the control group.

Six field trials, using terramycin preparations to control naturally occurring outbreaks of fowl cholera, were conducted. Each of six flocks responded to terramycin medication, but fowl cholera recurred in three of these flocks upon withdrawal of medication. The results of the field trials indicate the need for continued investigation into the use of terramycin for controlling fowl cholera.

Experiments are underway to test other antibiotics and certain chemotherapeutic agents to determine their usefulness in treating birds for fowl cholera.

The whole blood agglutination test was conducted in two farm flocks in which there were birds affected with chronic fowl cholera. Acute outbreaks would occur in both of these flocks when medication was withdrawn. Out of 421 chickens tested, 31 reactors were

found. The fowl cholera organism, *Pasteurella multocida*, was isolated upon bacteriological examination from seven of eight birds selected at random from reactors. The work with the fowl cholera antigen, to determine its value in controlling fowl cholera, will be continued. (Project 141. Leader: T. A. Dorsey, Veterinary Dept.)

Screw-worms and Secondary Maggots

True screw-worms (*Callitroga hominivorax*) were found infesting cattle in Hughes, Sully, Stanley, Armstrong, Dewey, and Haaken counties in 1953. The first case of the infestation of livestock came to the attention of the Experiment Station in July 1953. At that time Dr. R. S. Robinson, of the South Dakota Sanitary Board, submitted to the Station maggots taken from cattle in Stanley County. These were identified as true screw-worms. Following this a survey was made to find out how widespread was the outbreak of screw-worms.

This survey was conducted by W. Berndt, of the Station, and John Lofgren, of the South Dakota Extension Service. It covered the period from August 13 through August 28, 1953. Through the survey the outer boundaries of the infested area were determined and the severity of the infestation was learned. The livestock men in the area were alerted to the dangers of the insect pest, demonstrations of control were made, and control measures were recommended.

The true screw-worm does not winter over, in any of its stages, in South Dakota. The usual method that the screw-worm has of invading South Dakota is through the shipment of infested cattle into the state. Occasionally the screw-worm may spread into South Dakota through flight by flies when they reach the state's borders in neighboring states. Severe outbreaks occur in South Dakota only when infested cattle are shipped

into the state early in the year. This would permit a long period of time for the flies to produce a number of generations of offsprings. Then through flight by the flies the spread of the screw-worm could become extensive.

Samples of secondary maggots infesting livestock, principally sheep, were also sent to the Station during the year. Control measures for these maggots were recommended in all cases. (Project 220. Leader: H. C. Severin, Entomology-Zoology Dept.)

Cattle Grubs In South Dakota

The study of cattle grubs and their control, is now completed. Experiment Station Bulletin No. 435, entitled "Cattle Grubs and Their Control in South Dakota," has been published. (Project 163. Leader: W. L. Berndt, Entomology-Zoology Dept.)

A Systemic Treatment for Cattle Grubs

An attempt is being made to discover a chemical that can be fed or injected into cattle to kill young cattle grubs while they are still migrating through the tissues and before they reach the backs of the animals.

Young larvae are obtained from the gullets of slaughtered cattle and are exposed in dishes to various concentrations of candidate chemicals. Of the many chemicals tested, three show sufficient promise to warrant further tests. Several other observations were made on the possibility of developing grub immunity in cattle, and some very promising leads were uncovered. (Project 244. Leader: Wm. M. Rogoff, Entomology-Zoology Dept.)

Sporadic Bovine Encephalitis, see page 38

Farm Engineering

Conditioning of Wheat In Long Time Storage

In an attempt to find the best way to keep good quality wheat in long periods of storage in bin site structures, the South Dakota State College Agricultural Experiment Station and the Commodity Credit Corporation, through the South Dakota A. R. S., are cooperating on a project at the Onida bin site. A group of forty 3,000 bushel steel bins was filled with wheat of the 1952 crop. Eight bins were used, without ventilation for control bins, while all others had air ducts placed down the center. The remaining bins were equipped as follows: 8 with cupolas of special design 8 with 50 cu. ft. per. min. exhaust fans, 8 with 100 cu. ft. per. min. exhaust fans, and 8 with 200 cu. ft. per. min. exhaust fans.

All bins were filled with wheat in July and August, and the ventilating equipment installed in September. Thermocouples were placed in all bins

to measure temperatures. On October 10, all fans were started, at which time the bins' average temperatures were in the 60°F range. A few 80°F temperatures were noted.

The fans and cupolas accomplished their first purpose by lowering temperatures, for by January 1, the check bin average temperatures were 58°F while the largest fans had reduced their average bin temperatures to 36°F. Some fans were turned off at this time, and others running through a very cold January reduced parts of some bins to as low as 8°F. The remainder of the fans were then turned off. A beneficial result of the low temperatures was freedom from insect damage, although this was not a serious problem in any of the bins.

Moisture migration to the top center during winter time, with grain spoilage in the spring, is a common occurrence. A second goal was to break up this moisture migration by the use of the

small fans. After 8 months, data has been summarized, and it seems to indicate that the small fans and cupolas are moderately successful, but that the largest fans increased the top surface moisture accumulation as compared to no circulation of air in the check bins.

All grain was sound and dry to begin the storage season, being 10 percent, 11 percent, and 12 percent moisture content. In no place has moisture migration or absorption raised the grain above 15.6 percent. No spoilage has occurred. Federal inspectors will again grade the grain before it goes into its next and third year of storage. It is planned to have several additional bins equipped with horizontal tubes for the next year, and to put automatic controls (temperature, humidity, or both) on a few of the bins.

With millions of bushels of grain in storage and under loan agreement, it is important to keep this grain from deterioration in quality. Similar projects of 40 bins or more are in progress in Kansas, Iowa, and Indiana; the first dealing with winter wheat and the others with corn. All projects are set up on the same general pattern to accommodate statistical analysis. As one might expect, the varying climatic conditions between any two bin sites has given different results during the first season's comparison. (Project 246. Leader: H. H. DeLong, Agricultural Engineering Dept.)

Lightweight Concrete Aggregate from South Dakota Shales

Research on expanded shale for use as a lightweight concrete aggregate continued during the past year. Additional samples from various geological formations scattered throughout the state were investigated. Two light aggregate manufacturing plants produced at full capacity with the product seeing continued use by lightweight concrete block manufacturers in South Dakota and surrounding states.

Several state buildings have been erected utilizing this material. On some of these buildings weathering, freezing and thawing, stuccoing, insulating, and colorizing data were gathered on the lightweight blocks while in actual use.

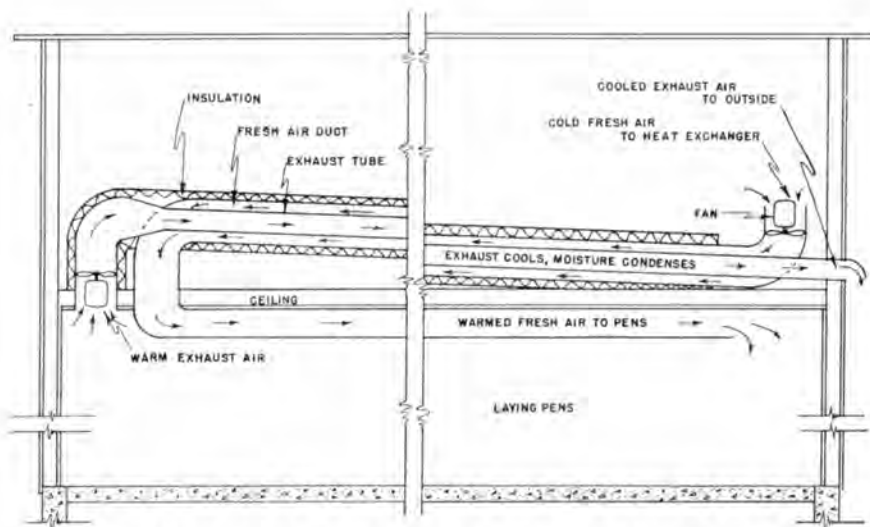
Work on ready-mix lightweight concrete on poured slab floors was inaugurated and is being continued at the present time. (Project 203. Leader: Dennis L. Moe, Agricultural Engineering Dept.)

Poultry House Ventilation

Studies of the ventilation of poultry houses have been continued, using the poultry house at Highmore Agricultural Experimental Substation. Recording thermometers were used to obtain a continuous record of indoor and outdoor temperatures. For the first part of the winter, ventilation was by means of the two-fan system originally installed in the building, with the small fan arranged to run continuously. This gave good control during moderate weather but cooled the house excessively in very cold weather. A larger flock would have improved conditions in this building.

Near the end of January a heat-exchanger unit was put into operation (see figure). With this unit the warm air being exhausted from the building warms the incoming fresh air, thus reducing the amount of heat lost in ventilating. Unfortunately for the records, the weather turned warm at about this time, and no results under very cold weather conditions were obtained. Preliminary estimates indicate that the use of the heat-exchanger will raise the average inside temperature by about 10°F., compared to the two-fan system, and also give adequate moisture removal. These observations will be continued.

Design of a dehumidifier to be used to remove moisture and recover waste heat during the winter and to cool the building in hot weather has been begun. It is planned to have the dehumidifier operating during part of the next win-



A schematic cross-section of a heat-exchanger ventilating system which can be installed in a poultry house

ter. (Project 232. Leader: T. R. C. Rokeby, Agricultural Engineering Dept.)

Sprinkler Possibilities in South Dakota

The work on the uniformity of water distribution from slow revolving sprinklers was completed. From an analysis of these data a condensation of the conclusions reached are: (1) Tall risers are superior to short risers. (2) Angle of wind with respect to lateral line has little or no effect. (3) A definite breaking point occurs between a 50-foot move between lines and a 60-foot move between lines. (4) High pressures are superior to low pressures. (5) Large quantities of water per nozzle result in better patterns than small quantities of water. (6) In winds of 8 miles per hour or greater, a head with only the range nozzle is more efficient than a head with both a range nozzle and a spreader nozzle. (7) A sprinkler head with a large water capacity spaced 40 feet on the line is as good as heads with one-half the water capacity spaced 20 feet on the line.

In this study, the distribution coefficient was the only criterion considered.

The conclusions may have to be modified when soil crusting, evaporation losses, labor schedules, rates of soil infiltration, size of water supply, type of equipment available, and the types of crops grown are considered in assessing the efficiency of sprinkler systems. Results of work will be published.

To further determine type of sprinkler head to be used preliminary tests were completed to determine amounts of water lost from the time it leaves the sprinkler head till it reaches the ground. The water amounts lost depend on climatic conditions such as temperature, relative humidity, and wind, and on mechanical variables such as operating pressure, type nozzle, water quantity, and time water is actually in the air. In coordination with this work, water management practices on the sprinkler irrigation of specialized garden crops are being studied. (Project 192. Leader: J. L. Wiersma, Agricultural Engineering Dept.)

This Trench Silo Was Built Above Ground, see page 6

The Roof Over Your Head, see page

60



A heat-exchanger ventilating system installed in the attic of the Highmore poultry house (see page 140). The exhaust air fan is in background, and fresh air fan is out of sight to right foreground. Heat-exchanger tubes are enclosed in the rectangular duct which has since been insulated

Farm Economics and Community Welfare

Economics of Soil Conservation

The effect of legumes and grasses on crop yields for corn and oats has been tentatively established for the Moody-Trent-Crofton-Ida soil association of southeastern South Dakota and the Barnes-Buse, Aastad soil association of eastern and central South Dakota.

The yield data prepared for the Barnes loam soil of eastern South Dakota indicates that farmers on Barnes loam can profitably grow approximately 20 percent grasses and legumes in crop rotations with excellent management and weather conditions similar to those prevailing from 1943 to 1950. If more grasses and legumes can be economically grown and utilized, then many

urgent agricultural problems, such as, crop surpluses, use of diverted acres, and soil erosion, may be partly solved.

South Dakota State College Agricultural Experiment Station Circular 105, "Economic Use of Grain and Forage in Livestock Production," is being published. This circular presents physical production data which show inputs of various combinations of grain and forage and the outputs of livestock products in response to these feed combinations. These data will be useful to farmers in deciding whether to grow more grasses and legumes; and if more grasses and legumes are grown, what combination of livestock enterprises and feeding practices will efficiently utilize

the additional forages produced for the greatest net profit on a whole farm basis. (Project 211. Leaders: Russell Berry (on leave), Canute Johnson, Agricultural Economics Dept.)

Farm Income Potentials Under Irrigation

Agricultural Economics Pamphlet 51, "Base Prices for Long-term Farm Budgets in South Dakota," was completed. This contains price and cost data needed in preparing long-term farm budgets of alternative farm plans which involve major, long-term changes in the farm business, such as, changes in cropping system and livestock enterprises.

Planning by means of budgets is also essential in determining the economic feasibility of various farm practices. The production plans and practices most farmers want to put into operation are those which promise to yield the largest net returns over a period of years and at the same time maintain or increase the productivity of land, labor, and capital investments.

The first draft of a manuscript, "An Economic Comparison of Dry-land Farming and Potential Irrigation Farming in Central South Dakota," was completed. In this study budgets for dry-land and partly irrigated farms in the Oahe area were compared. Three sizes of farms: 800-, 480-, and 320-acre farms, and three major kinds of farm organization: cattle-hog, dairy-hog, and sheep-hog farms were used. Comparisons were made on the basis of equal acreages, and equal investments with widely differing results. Additional capital investment may be necessary in making the transition from dry to irrigated farming. Adequate credit facilities may be the key to making irrigation farming successful in the Oahe area if it is physically possible to irrigate the land.

Agricultural Experiment Station Bulletin 432, "TVA Land Acquisition Experience Applied to Dams in the

Missouri Basin," was also published. (Project 198. Leaders: Russell L. Berry (on leave), Canute M. Johnson, Agricultural Economics Dept.; Rex D. Helmfine, USDA.)

Farm Records and Management

In most areas farm incomes are down so that the farmer is getting from 15 to 20 percent less cash income than he received during the wartime peak income period. Within the two areas, in north central South Dakota and southeastern South Dakota, there are many individual farm variations. Some of these farm variations are accounted for by the difference in weather, others by particular management, and some by other factors. Grain farmers were, in general, less severely squeezed than the livestock farmer during the year 1953.

Many of the farmers feel the income tax record is practically the only use for farm records. However, when discussing management or the necessity for getting credit, each farmer turns to his record book for basic data needed. After this sort of discussion many of the record cooperators felt that the farm and family record book is a valuable addition to the kit of farm tools.

The record project, as such, is being discontinued in 1954, and an attempt is being made to organize one or more farm management associations. These associations will involve keeping records similar to the ones previously used but will also include detailed management planning and some supervision. The management associations will hire a fieldman to help the cooperators on their management problems. (Project 137. Leader: Allan Clark, Agricultural Economics Dept.)

Farm Leasing Practices

The North Central Regional manuscript on rental practices, "Farm Rental Practices and Problems in the Midwest," is being published. Farmers in

South Dakota, and the Agricultural Experiment Station, participated in the rental practice survey which provided data for this manuscript.

This study suggests that improved landlord-tenant relations and leasing practices may be brought about by at least four methods; namely, (1) increased length of leases, (2) development of satisfactory methods for sharing both costs and income, (3) improvement of land and buildings, and (4) improved farm practices.

Leases based upon acceptable economic principles of production and product sharing would result in: (1) larger income for both the landlord and the tenant and (2) better use and allocation of resources on any particular farm.

The results of a survey of 317 South Dakota farm landlords indicate that landlords prefer the short-term lease as a bargaining tool in dealing with the tenant. A manuscript presenting the results of this survey is being prepared for publication next year.

An Extension Circular, Farm Lease Arrangements, based on the results of these two surveys is to be prepared. (Project 147. Leaders: Russell L. Berry (on leave), Canute Johnson, Agricultural Economics Dept.)

Economic Trends

Information on economic trends is necessary as an aid to farmers and to all other business enterprises to enable those concerned to make intelligent plans for the future.

A manuscript has been prepared and is in process of publication showing the 50-year trends in South Dakota agriculture as revealed by the United States Census reports up to and including the 1950 census.

Data have been secured showing the changes in the farm land market in eight counties of South Dakota during the year 1953. This a continuation of the study reported in Bulletin No. 413,

"Farm Land Market Trends in South Dakota 1941-1950" and gives a complete history of farm land sales within these eight counties since 1941. Particular attention is given to determining the extent of speculation in farm land within the prospective irrigation area of central South Dakota.

The study of farm land mortgage foreclosures has been extended to include 1953 data. The 10 foreclosures in South Dakota involving 2,407 acres in 1953 is the second lowest in number and in acreage during the past 33 years.

Weather conditions are the chief limiting factors in South Dakota agriculture and an intensive study is being made of weather data from about 70 observation stations over the state through the use of I. B. M. punch cards. A study showing probability of frost occurrence at 12 locations over the state has been completed and is in process of publication. Work has been started on a climatological atlas to provide information on long-time weather conditions as an aid to agricultural production specialists in developing crops and practices better adapted to local weather conditions. This more detailed weather information will also benefit farmers directly. (Project 157. Leaders: Gabriel Lundy, Ray Pengra, Agricultural Economics Dept.)

Attaining and Maintaining Farm Ownership

A 13-state regional study of ways of helping young farm families get established in farming is continuing. This work is focused on young families who lack substantial family assistance. The emphasis is on showing young people how they can best help themselves to success in farming.

South Dakota is included in this effort which involves analysis of a large number of individual experiences and study of various ways of obtaining uses of land and capital. Emphasis is placed

on the establishment of adequate, efficient farm business units, not merely on a minimum start in farming. (Project 166. Leader: Max Myers, Agricultural Economics Dept.)

Marketing Dairy Products

The problem of marketing farm separated cream continues to be important in the state because of the present surplus of butter and dried skim milk. During 1953, the farm production of milk and cream increased in South Dakota for the first time in several years, probably because of reduced farm incomes. A bulletin entitled "Dairy Marketing in the Plains States - Its Pattern and Prospects", now being printed, attempts to throw some light on the nature of dairying and dairy marketing in this area for the specific purpose of bringing out the major factors which may influence the future of dairying in the area.

The bulletin's major conclusions are that unless there are important changes in technology, further long-run declines in milk production—particularly in areas of sparse production—are likely. However, in periods of low farm incomes, sales of milk and farm separated cream may increase. Further shifts by farmers from farm separated cream sales to whole milk sales will be limited in extent and will continue to be slow.

Butter quality problems are discussed more thoroughly in another manuscript now nearing completion. Low quality has repeatedly been blamed as one factor which turns consumers towards oleomargarine. Undesirable characteristics in butter can originate on the farm, because of improper handling and storing of cream, or in cream stations, or in the plants themselves. To bring out more clearly the quantitative relationships between procurement and processing of cream may contribute towards an improvement in the quality of South Dakota butter. (Project 201. Leaders: E.

Feder, Agricultural Economics Dept.; D. F. Breazeale, Dairy Dept.)

Grain Marketing Problems

Principal findings of a study of major problems in grain marketing in South Dakota included: the problems of excessive moisture and other conditions detrimental to long term grain storage; mixed grains and mixed varieties; inadequate grain storage facilities on the farm, in elevators, and in terminals; inadequate facilities for transportation of grain to terminals during harvest time. Price discrimination against South Dakota malting barley and faulty grading and handling of grains were also indicated by farmers as problems they face in some areas. In general, quality and sanitation of food grains is also a serious problem in South Dakota.

This study indicates areas where additional research work in grain marketing is most needed in the next few years. A final report of the findings will be published early in the next fiscal year. (Project 224. Leader Richard Newberg, Agricultural Economics Dept.)

The Best Time to Sell Livestock

One of the most important problems facing the livestock producer is when to sell livestock to obtain the best returns. In this study seasonal price trends are computed and various production plans are compared to determine which methods give the best returns under different economic conditions. Data from this study have been used in preparing budgets for feeder outlook meetings and for budgets in the Extension Service's Farm Family Planning Program. (Project 226. Leader: O. Nervik, Agricultural Economics Dept.)

Methods and Costs in the Retail Distribution of Meat and Meat Products

This study is a regional study including the North Central States. A survey of retail stores in the region has been

made, and data on methods and costs of retail distribution of meat have been obtained. It was found that there was a definite relationship between volume of meat handled in each store and cost of selling. For instance, the pounds of meat handled per man hour of labor in meat departments varied from 12 pounds in stores having sales of less than \$1,000 per month to 30 pounds in stores having sales of between \$10,000 and \$20,000 per month.

The next step in this study is an examination of the extent to which meat markets reflect consumer preferences to livestock producers. Price data for retail cuts will be obtained from retail meat stores over a period of time. A composite carcass price will be developed from this, and a comparison will be made between this composite price and whole-sale prices of carcasses and also with prices paid to producers. (Project 228. Leader: O. Nervik, Agricultural Economics Dept.)

Economical and Practical Problems in Developing Market News Service for Feeder Cattle and Feeder Lambs at Local Auction Markets

Livestock auctions are important market outlets for South Dakota livestock. Over 800,000 head of cattle, 400,000 hogs and 255,000 lambs were sold through auction markets in 1952-53 in the state. There is a need for bringing information about prices and receipts at these markets to producers and buyers.

This project was initiated to determine whether a market news service covering auction sales could be organized. It is a cooperative project between the state Department of Agriculture which is responsible for the actual reporting, the South Dakota Experiment Station, and the Extension Service. During the fall and early winter, trained reporters have given reports from an average of 10 auction markets in the state.

Much of the research work this year has been concerned with the practical problems of reporting. Among these are selection of markets to be reported, methods of reporting and dissemination of market reports. This winter and spring a survey of producers and buyers was made to obtain their opinions and suggestions for improvement of this service. (Project 243. Leader: O. Nervik, Agricultural Economics Dept.)

Lessons Learned on the Belle Fourche Irrigation Project

The Belle Fourche Irrigation Project, Butte County, South Dakota was approved by the Secretary of the Interior of the United States on May 10, 1904, and Reclamation funds were set aside for its construction. This year, 50 years later, a study of this project's development its problems, and the solution of these problems will be published. During the 50-year period, many adjustments have taken place on the project. While irrigated farms on the project have grown in size, the total number of irrigated farms and the population on these farms has decreased. In addition, changes in crop and livestock production patterns have been taking place.

The main objective of this research is to determine the significant lessons learned from the experience of the irrigation farmers on the Belle Fourche Project. As it is one of the oldest Federal irrigation projects in the Nation, the experience of South Dakota farmers on it should prove invaluable to those persons considering further irrigation development within the state. (Project 64. Leaders: W. F. Kumlien and M. P. Riley, Rural Sociology Dept.)

Population Changes and Implications for the Development of Agriculture and Rural Life

This is a contributing research project to North Central Regional Project 18. The analysis in the present phase deals

with the interrelationships of demographic, agricultural, and industrial characteristics from 1940 to 1950. The data are being analyzed for the state, state economic areas, and counties. Data by economic areas are being supplied the North Central Regional Committee for a regional publication. The publication should be published this year.

A manuscript, "Recent Population Trends in Relation to Resources Development in South Dakota" has been submitted for publication to the Experiment Station. A manuscript based upon

the current phase of the analysis is planned. (Project 222. Leader: Robert M. Dimit, Rural Sociology Dept.)

Financing Cooperatives, see page 15

Commercial Expansion from Irrigation, see page 31

A Better Education for Your Children, see page 62

Equalizing Your Farm Property Tax, see page 67

Talking over Farmer-Debtor Relief Legislation, see page 79

Home Economics

Studies of Heat Transfer of Wool Fabrics Completed

Measurements of heat transfer for three weights of wool serge and five woolen flannels of varying new and re-used wool composition, both before and after varying amounts of wear and dry cleaning, have been completed. Thermal conductivity of the fabric (c) and the conductivity per unit fabric thickness (K) have been calculated from these data. Statistical analyses of the data are being made and the findings will be summarized and prepared for publication. (Project 196. Leaders: Lillian O. Lund, Home Economics Dept.; and Ethel L. Phelps, Minnesota Agricultural Experiment Station.)

Comparison Studies of Wool and Wool Blends

Using fabrics of all wool as a basis for comparison, suitings made from blends of wool and chemically manufactured fibers are being studied in the laboratory. Some of the fibers included are acetate, Acrilan, Dacron, Dynel, Nylon, rayon, Orlon, and Vicara. Physical measurements which have been completed are fabric count, weight per square yard, thickness, strength and elongation. (Project 215. Leaders: Lil-

lian O. Lund, Home Economics Dept.; Ethel L. Phelps, Minnesota Agricultural Experiment Station.)

Nutritive Value of South Dakota Grown Fruits and Vegetables

For the past 3 years studies on the nutritive value and use of South Dakota-grown fruits and vegetables have been in progress in the Home Economics Department of the South Dakota Station. The concentration of ascorbic acid has been determined and recipes for the use of these foods have been developed.

Nanking cherries, several varieties of sand cherries, and plums are some of the fruits under investigation. It was found that these fruits contain between 10 and 30 milligrams of ascorbic acid per 100 grams of fruit. Use of these fruits, which are becoming increasingly available in shelterbelts in the state, provide variety in addition to supplying substantial amounts of this much needed vitamin. There has been demand for the recipes which have been developed. These have included jelly, pie, cobbler, muffins, and coffee cake.

During the summer of 1953, a number of varieties of summer squash were studied. Ascorbic acid content of this

vegetable averaged about 20 milligrams per 100 grams of fresh squash. Recipes for French fried, scalloped, and stuffed squash have created considerable local interest in this less-well-known vegetable. (Project 210. Leaders: Lida M. Burrill and Beth Alsup, Home Economics Dept.)

Breakfast Habits of South Dakota Women

Most nutritionists are convinced that eating a good substantial breakfast will pay high dividends in the form of greater work efficiency and less mid-morning fatigue. Such a breakfast, they believe, should supply from one-fourth to one-third of the day's allowance of calories and of protein. From a study of the 24-hour recall diaries of 339 women from 30 to 92 years of age living in South Dakota, it was found that, although less

than 1 percent of the women skipped breakfast entirely, about three-fourths of them ate breakfasts supplying less than the recommended amount. The women living in the country tended to have more adequate breakfasts than those in cities and towns.

The four most popular breakfasts were (1) toast, roll, or cereal, and coffee; (2) fruit, toast, or roll, or cereal, and coffee; (3) fruit, both toast and cereal, and coffee; (4) cereal, toast, and coffee. Sixty-two percent of the breakfasts were of these types. Eggs appeared on only one-fifth of the breakfasts. (Project 178. Leaders: Lida M. Burrill and Beth Alsup, Home Economics Dept., in cooperation with other stations in the North Central Region and the Human Nutrition Research Branch as part of Project NC-5, "The Nutritional Status and Dietary Needs of Population Groups in the North Central Region.")

Substation Report

Cottonwood Range Field Station

F. W. WHETZAL, *Superintendent*

New Forage Legumes and Grasses are Being Developed

Both breeding and testing of forage legumes is underway at this Substation. Duplicate clonal and progeny tests of the H2 and CK matrices were established in 1953. The objective was to get information on the amount of genotype X environmental interaction and, at the same time, determine the adaptability of these genetic stocks to the soil and climatic conditions prevailing west of the river. From the K-nursery (composed of clones and intercross progeny with the root-proliferating habit) previously established, some eight plants were selected and brought to Brookings for intercrossing in the greenhouse. This task has not been satisfactorily accomplished as yet.

In testing 15 strains of alfalfa under grazing, Ladak, Rhizoma, and two unnamed locally selected strains were most promising and definitely superior to Nomad, Grim, Ranger, Cossack, and Talent.

In addition to yield tests, approximately 4,000 spaced plants of Ree wheatgrass and crested wheatgrass are under evaluation. Seed set determinations and other agronomic evaluations have been made on the plants and selections from these have been crossed in the greenhouse in 1954. For a detailed report see page 107. (Projects 74 and 182. Leaders: M. W. Adams and J. Ross, Agronomy Dept.)

Wheat Good Following Sorghum or Fallow

Results from the rotation trials reveal that wheat yields following sorghum were just as high as those following

fallow. Moisture was not a limiting factor. For a report of the project see page 102. (Project 4. Leader: B. L. Brage, Agronomy Dept.)

Station Corn Hybrids Superior

About 25 corn hybrids and open-pollinated varieties of corn were appraised for their suitability and adaptability. Also, new crops such as sunflower, safflower and castor bean are being appraised. The new oat variety, Dupree, is being increased at the Station for foundation seed supply for the local area. For reports on projects see page 104. (Projects 25, 61, 148, and 181. Leaders: D. Harpstead, V. A. Dirks and C. J. Franzke, Agronomy Dept.)

Nutritive Value of Prairie Hay

Experiments on the effect of time of harvest on the nutritive value of prairie hay were continued. Feeding trials were conducted with calves at Cottonwood, Highmore, and Eureka. There was some variation in rates of gain obtained with the various hays at each substation. In most cases the gains were less on the older hays. For a detailed report see page 123. (Project 120. Leaders: L. B. Embry and L. E. DuBose, Animal Husbandry Dept.; O. E. Olson, Station Biochemistry; and J. G. Ross, Agronomy Dept.)

Improvement of Beef Cattle Through Breeding

This project was continued. The objectives of the experiments are to investigate methods of selection for the improvement of beef cattle and to investigate the effects of inbreeding and the crosses of inbred lines. For a detailed report see page 124. (Project 167. Leader: C. A. Dinkel, Animal Husbandry Dept.)

Vitamin A Supplement for Range Cows

Study of the effect of adding vitamin A to a basal ration of range grass and

1 pound of a 38-percent protein supplement was continued. This year 54 grade 2-year-old Hereford heifers were involved in the experiment. For a detailed report see page 128. (Project 217. Leaders: J. K. Lewis, Animal Husbandry Dept.; O. E. Olson and A. Halverson, Station Biochemistry.)

Summer Grazing of Beef Cows for Calf Production

Intensity of grazing studies were continued. For a more detailed report, which includes a table showing a summary of the stocking rates and animal production data, see page 127. (Project 216. Leaders: J. K. Lewis, Animal Husbandry Dept.; O. E. Olson, Station Biochemistry.)

Performance Tests with Poultry

The study of how different breeding methods affect the performance of poultry has been continued. For a detailed report see page 135. (Project 194. Leaders: D. G. Jones, Wm. Kohlmeier, Poultry Dept.)

Central Substation, Highmore

WADE R. PRINGLE, *Superintendent*

Manure Very Beneficial to Oats and Wheat

The effect of manure was very pronounced in a sorghum-wheat-oats rotation. The yields of wheat and oats were increased by 9 to 12 bushels per acre respectively. For a report of the project see page 102. (Project 4. Leader: B. Brage, Agronomy Dept.)

Grasses and Legumes Tested

A yield test of different grasses has shown Ree wheatgrass and bromegrass to be the highest yielding grasses. Work on legumes has been confined to testing of sweet clover species and strains. Only preliminary data are available from the test seeded in 1952 (the summer

drought in 1952 caused stands to be too irregular for harvesting). A new test was seeded in 1953 on which no data has been gathered as yet. For a more detailed report see page 107. (Project 74 and 182. Leaders: J. Ross and M. W. Adams, Agronomy Dept.)

New Crop Varieties Tested

Several hundred new strains of wheat, oats, barley, and sorghum were grown and appraised for their suitability and adaptability. Also, new crops such as sunflowers, safflowers, and castor beans are being tried. The new variety of wheat, Selkirk, and the new oats, Waubay and Dupree, yielded very well at the Station. For more detailed reports on projects see page 104. (Projects 25, 61, 148 and 181. Leaders: D. Harpstead, V. A. Dirks and C. J. Franzke, Agronomy Dept.)

Performance Tests with Poultry

The study of how different breeding methods affect the performance of poultry has been continued. For a detailed report see page 135. (Project 194. Leaders: D. G. Jones, Wm. Kohlmeier, Poultry Dept.)

Sorghum Seed Treatment

The sorghum seed treatment experiments which have been conducted at Brookings and Highmore for several years were continued. For a detailed report see page 118. (Project 110. Leader: C. J. Mankin, Plant Pathology Dept.)

Nutritive Value of Prairie Hay

Experiments on the effect of time of harvest on the nutritive value of prairie hay were continued. Feeding trials were conducted with calves at Highmore, Cottonwood, and Eureka. For a detailed report see page 123. (Project 120. Leaders: L. B. Embry and L. E. DuBose, Animal Husbandry Dept.; O. E. Olson, Station Biochemistry; and J. G. Ross, Agronomy Dept.)

Forage Grass Diseases

Fungicidal treatments of grass seeds were used at Brookings and Highmore in attempts to improve grass stands. For a more detailed report see page 120. (Project 250. Leader: C. J. Mankin, Plant Pathology Dept.)

Poultry House Ventilation

Recording thermometers were used in the poultry house to obtain a continuous record of indoor and outdoor temperatures. For the first part of the winter ventilation was by means of a two-fan system. This gave good control during moderate weather but cooled the house excessively in cold weather.

In January a heat-exchanger unit was installed. Preliminary estimates indicate that the heat-exchanger unit will raise the average inside temperature by about 10° F., compared to the two-fan system. For a detailed report see page 140. (Project 232. Leader: T. R. C. Rokeby, Agricultural Engineering Dept.)

North Central Substation, Eureka

ALBERT DITTMAN, *Superintendent*

Sweet Clover Benefits Outstanding to Oats

1953 was a good year for corn and oats at Eureka. Sweet clover included in the rotation had a 5 bushel adverse effect on corn yields, but caused a 35 bushel increase in the yield of oats. Corn in all cases followed the sweet clover and the oats followed corn. The yields for corn and oats in the sweet clover rotation were 56 and 80 bushels per acre, respectively. For a more detailed report see page 102. (Project 4. Leader: B. Brage, Agronomy Dept.)

Tame Grasses Yield Most

Yield tests of different grasses grown with and without alfalfa have demonstrated that a mixture yields from two to three times that of a grass by itself.

Ree wheatgrass, crested wheatgrass and brome grass are superior in yield when compared with other common grasses. Several varieties of alfalfa are being appraised for their survival and persistence and under severe grazing by livestock. Trials are under way to determine the best method for establishing legumes in sod. For a more detailed report see page 107. (Project 74 and 182. Leaders: J. Ross and M. W. Adams, Agronomy Dept.)

New Crop Varieties Tested

Many new strains of sorghum, corn, wheat, oats, barley, and flax were grown and appraised for their adaptability and suitability. New crops such as sunflowers, safflowers, and castor beans also were tested. The data indicate that the mid-season small grain varieties have yielded the best. Station corn hybrid S. D. 220 again performed well this season. For more detailed reports see pages 105 to 107. (Projects 25, 61, 66, 148, 151 and 181. Leaders: D. Harpstead, V. A. Dirks, D. Kratochvil, D. B. Shank, and C. J. Franzke, Agronomy Dept.)

Nutritive Value of Prairie Hay

Experiments on the effect of time of harvest on the nutritive value of prairie hay were continued. Feeding trials were conducted with calves at Eureka, Highmore, and Cottonwood. For a detailed report see page 123. (Project 120. Leaders: L. B. Embry and L. E. DuBose, Animal Husbandry Dept.; O. E. Olson, Station Biochemistry, and J. G. Ross, Agronomy Dept.)

Forage Crops for Turkeys

Experiments were conducted to study the effect of strip planting of corn and rape as range for growing turkeys. The combination of the corn and rape planted in this way was more satisfactory than the control range of oats and rape sown together. For a report of the project see page 134. (Project 79.

Leaders: Wm. Kohlmeyer, and C. W. Carlson, Poultry Dept.)

Systems of Breeding Swine

Research in swine breeding was continued at Brookings and at the Eureka substation. For a detailed report see page 123. (Project 124. Leader: J. W. McCarthy, Animal Husbandry Dept.)

Performance Tests with Poultry

The study of how different breeding methods affect the performance of poultry has been continued. For a detailed report see page 135. (Project 194. Leaders: D. G. Jones, Wm. Kohlmeyer, Poultry Dept.)

U. S. Newell Field Station

HARRY E. WEAKLY, *Superintendent*

Swine Production For Irrigated Areas

Work on swine production in the irrigated area of western South Dakota is being continued. For a more detailed report see page 123. (Project 132. Leader: J. W. McCarthy, Animal Husbandry Dept.)

Irrigated Pastures in Western South Dakota

Cattle and sheep are being pastured on irrigated alfalfa-brome to determine rate of gain, carrying capacity, and effect of livestock on the longevity of the pasture. For a more detailed report of the project see page 129. (Project 229. Leaders: Robert M. Jordan, James K. Lewis, Animal Husbandry Dept.; W. W. Worzella, Agronomy Dept.)

Feeder Lamb Responses to Bentonite

Trials were continued to determine the effect of adding bentonite to lamb fattening rations. There was no significant effect. For a more detailed report on this project and also on the effect of adding molasses to lamb fattening ra-

tions see page 129. (Project 233. Leaders: Robert M. Jordan, Animal Husbandry Dept.)

Antelope Range Field Station

WILLIAM R. TREVILLYAN,
Superintendent

Levels and Length of Time of Concentrate Feeding of Range Ewes

Wintering range ewes under range conditions to determine optimum level of supplemental feeding has been in progress for 3 years. For a report of this year's findings see page 124. (Project 159. Leaders: J. K. Lewis, G. T. King, L. B. Embry, Animal Husbandry Dept.)

Improvement of Beef Cattle Through Breeding

This project was continued. The objectives of the experiments are to investigate methods of selection for the

improvement of beef cattle and to investigate the effects of inbreeding and the crosses of inbred lines. For a detailed report see page 124. (Project 167. Leader: C. A. Dinkel, Animal Husbandry Dept.)

Summer Grazing Studies with Sheep

The grazing experiment with 400 range ewes, which was started in 1951, was continued. It appears adequate forage was available under all treatments due to unusually favorable precipitation. For a more detailed report see page 125. (Project 177. Leaders: J. K. Lewis, G. T. King, and L. B. Embry, Animal Husbandry Dept.)

Sheep Parasite Control

The study of internal parasite infestation in sheep was continued. For a more detailed report see page 137. (Project 139. Leader: G. S. Harshfield, Veterinary Dept.)

Publications

Bulletins

- The Influence of Migration upon South Dakota's Population, 1930-50.** Bulletin 431. By John P. Johansen.
- TVA Land Acquisition Experience Applied to Dams in the Missouri Basin.** Bulletin 432. By K. Kristjansen.
- Soft Corn — Feeding and Handling.** Bulletin 433. By O. E. Olson, Geo. Gastler, W. C. McCone, C. C. Wilson, R. M. Jordan, Turner Wright, Wm. Kohnmeyer, H. H. DeLong, C. M. Nagel, A. N. Hume, and W. W. Worzella.
- Financing Cooperatives.** Bulletin 434. By Ottar Nervik and Robert Gunderson.
- Cattle Grubs and Their Control in South Dakota.** Bulletin 435. By John A. Lofgren, I. H. Roberts, W. L. Berndt, and Karl Rasmussen.
- Waubay and Dupree — Two New Oats for South Dakota.** Bulletin 436. By V. A. Dirks.
- Farrowing Systems — Their Effects on Return in Hog Production.** Bulletin 437. By R. C. Wahlstrom, Richard F. Wilson, and Turner Wright.
- Dairy Marketing in the Northern Great Plains.** Bulletin 438. By Ernest Feder.
- Soils of Spink County.** Bulletin 439. By F. C. Westin, Geo. Buntley, W. C. Moldenhauer, and F. E. Shubeck.

Circulars

- Corn Performance Tests — 1953.** Circular 101. By D. B. Shank.

- Chemical Control of Weeds.** Circular 102. By Lyle Derscheid.
- Progress in Agricultural Research at the North Central Substation.** Circular 103. By Agronomy, Animal Husbandry, Poultry, Agricultural Engineering, Horticulture, and Plant Pathology Departments.
- Soil Moisture Depletion by Irrigated Crops Grown in South Dakota.** Circular 104. By L. J. Erie and Niel Dimick.
- Economic Use of Grain and Forage in Livestock Production.** Circular 105. By E. Stangland and C. Johnson.
- Alfalfa Hay, Alfalfa Silage and Corn Silage for Fattening Lambs.** Circular 106. By R. M. Jordan.
- Irrigation Research in the James River Area — A 5-Year Progress Report.** Circular 107. By Agronomy, Animal Husbandry, Agricultural Engineering, Horticulture, and Plant Pathology Departments.
- Feeding Pigs Trace-mineralized Salt.** Circular 108. By R. C. Wahlstrom and R. L. Wilson.
- Soil Survey and Land Valuation for Tax Purposes.** Circular 109. By A. J. Klingelhoets and F. C. Westin.
- Economics of Federal Irrigation Projects in the Missouri Basin.** Circular 110. By O. Nervik, K. Kristjansen, W. Schutz, and S. Stangland.

Journal Articles By Staff Members

Agronomy

- J-323 D. D. Harpstead, J. G. Ross, C. J. Franzke. The Nature of Chromatin Changes of Colchicine-Induced Variants in Sorghum. *Journal of Heredity*, 1954.

Animal Husbandry

- J-308 E. A. Pierce. The Effects of Rations Containing Antibiotics on the Chemical Composition and Physical Characteristics of Pork Carcasses. *Journal of Animal Science*, 1953.
- J-310 R. M. Jordan. Thyroprotein for Lactating Ewes and Its Effect on Lamb Weights. *Journal of Animal Science*, 1953.
- J-314 R. C. Wahlstrom. The Effect of Penicillin and B-Vitamins on the Growth of Pigs Fed Different Levels of Protein. *Journal of Animal Science*, 1954.
- J-319 R. M. Jordan, A. E. Dracy, D. D. Shaffhausen. Effect of Amount of Oxytocin and Type of Injection of Milk Let-Down of Sheep. *South Dakota Academy of Science*, 1954.

Dairy

- J-320 A. E. Dracy, R. M. Jordan, D. D. Shaffhausen. The Effect of Clamping the Esophagus upon Gas Accumulation in the Rumen and the Well-Being of Sheep. *South Dakota Academy of Science*, 1954.

Entomology

- J-321 W. L. Berndt. A Short Description of the Larva of the European Scavenger Fly, *Chrysomya demandata* Fabr. (Otididae). *Kansas Entomological Society Journal*, 1954.

- J-322 H. C. Severin. A Gynandromorph of *Melanoplus Mexicanus* phase *spretus* (Walsh). (Orthoptera). *Physche*, 1954.
- J-327 V. H. Lee, Wm. Rogoff. The Seasonal Occurrence of Cattle Grubs in the Gulleets of Cattle. *South Dakota Academy of Science*, 1954.

Poultry

- J-211 C. W. Carlson, E. Guenther, Wm. Kohlmeyer, O. E. Olson. Some Effects of Selenium, Arsenicals, and Vitamin B₁₂ on Chick Growth. *Poultry Science Journal*, 1953.
- J-312 R. A. Wilcox, C. W. Carlson, Wm. Kohlmeyer, G. F. Gastler. The Availability of Phosphorus from Different Sources for Poults Fed Purified Diets. *Poultry Science Journal*, 1953.
- J-324 R. A. Wilcox. Four Percent Sodium Bentonite in a Turkey Starter Diet and the Results and Four-Week Weights of BSW Poults. *South Dakota Academy of Science*, 1954.
- J-325 R. A. Wilcox, C. W. Carlson, Wm. Kohlmeyer, Geo. Gastler. The Effect on Different Levels of Phosphorus and Calcium on the Body Weight of Growing Turkeys. *South Dakota Academy of Science*, 1954.

Station Biochemistry

- J-316 Edw. C. Berry, Robt. Pengra. Respiratory Studies of *Saccharomyces Cerevisiae* in the Presence of Selenium. *South Dakota Academy of Science*, 1954.
- J-317 A. W. Halverson, C. M. Hendrick. Negative Relation of the Selenium Protective Factor and the Anti-Vitamin B₆ Principle of Linseed Oil Meal. *South Dakota Academy of Science*, 1954.
- J-318 Oscar E. Olson, A. W. Halverson. Effect of Linseed Oil Meal and Arsenicals on Selenium Poisoning in the Rat. *South Dakota Academy of Science*, 1954.
- J-326 A. W. Halverson, C. M. Hendrick. Effect of Trace Minerals and Other Dietary Ingredients upon Vitamin "A" Stability in Stored Poultry Diets. *Poultry Science Journal*, 1954.

Station Plant Pathology

- J-313 Allyn A. Cook. A Foliate Disease of Potato Induced by *Chaetomium* Species. *Phytopathology*, 1954.
- J-315 Allyn A. Cook. Reaction of *Lycopersicon* Species to Regional Isolates of *Septaria Lycopersici*. *Phytopathology*, 1954.

Veterinary

- J-309 G. S. Harshfield, H. A. Wenner, R. W. Menges. Sporadic Bovine Encephalomyelitis. 3. Efforts to Reproduce the Disease in Calves, with Reference to the Role of Poliomyelitis Viruses in Experimental Infection. *American Journal of Hygiene*, 1953.

Experiment Station Staff

Regents of Education

HONORABLE E. M. MUMFORD — Howard
 HONORABLE MRS. H. T. DORY — Watertown
 HONORABLE FRANK CUNDILL — Isabel
 HONORABLE ERIC HEIDEPRIEM — Custer
 HONORABLE L. W. ROBINSON — Mitchell

Executive

HONORABLE MRS. H. T. DORY — Regent Member
 HONORABLE FRANK CUNDILL — Regent Member
 JOHN W. HADLEY, Ed.D. — President
 A. M. EBERLE, A.M. — Dean of Agriculture
 J. B. JOHNSON, M.Agr. — Director

J. P. DODDS, Ph.D. _____ Comptroller
ELVA O. FEUERHELM _____ Secretary

Agricultural Economics

MAX MYERS, Ph.D. _____ Agr. Economist
GABRIEL LUNDY, M.S. _____ Economist
ERNEST FEDER, Ph.D. _____ Associate
OTTAR NERVIK, Ph.D. _____ Associate
RUSSELL BERRY, M.S. _____ Assistant
ALLEN A. CLARK, M.S. _____ Assistant
CANUTE JOHNSON, M.S. _____ Assistant
R. R. NEWBERG, M.S. _____ Assistant
REX HELFENSTINE, M.S. _____ Agr. Economist
(BAE, USDA)

Agricultural Engineering

H. H. DELONG, M.S. _____ Agr. Engineer
J. L. WIERSMA, M.S. _____ Assistant
D. L. MOE, M.S. _____ Assistant
T. R. C. ROKEBY, M.S. _____ Assistant
G. C. ZOERB, M.S. _____ Assistant
NIEL DIMICK, B.S. _____ Irriga. Engineer
(SCS, USDA)

Agronomy

W. W. WORZELLA, Ph.D. _____ Agronomist
A. N. HUME, Ph.D. _____ Agronomist Emeritus
L. F. PUHR, Ph.D. _____ Agronomist
C. J. FRANZKE, B.S. _____ Agronomist
D. B. SHANK, Ph.D. _____ Agronomist
L. O. FINE, Ph.D. _____ Agronomist
M. W. ADAMS, Ph.D. _____ Associate
L. DERSCHIED, Ph.D. _____ Associate
F. C. WESTIN, Ph.D. _____ Associate
J. G. ROSS, Ph.D. _____ Associate
A. J. KLINGELHOETS, M.S. _____ Associate
F. E. SHUBECK, Ph.D. _____ Associate
B. L. BRAGE, Ph.D. _____ Assistant
V. A. DIRKS, M.S. _____ Assistant
D. D. HARPSTEAD, M.S. _____ Assistant
D. E. KRATOCHVIL, M.S. _____ Assistant
WM. MOLDENHAUER, M.S. _____ Assistant
GEO. BUNTLEY, M.S. _____ Assistant
PAUL L. CARSON, M.S. _____ Assistant
RALPH CAMPBELL, M.S. Assistant (BR, USDA)

Animal Husbandry

A. L. MUSSON, Ph.D. _____ Animal Husbandman
TURNER WRIGHT, M.S. _____ Assoc. Prof. Emeritus
C. A. DINKEL, Ph.D. _____ Associate
R. C. WAHLSTROM, Ph.D. _____ Associate
R. M. JORDAN, Ph.D. _____ Associate
L. B. EMBRY, Ph.D. _____ Associate
J. W. MCCARTY, M.S. _____ Associate
ELLIS A. PIERCE, M.S. _____ Assistant
W. C. MCCONE, M.S. _____ Assistant
C. P. WILDER, B.S. _____ Assistant
J. K. LEWIS, M.S. _____ Assistant
G. T. KING, M.S. _____ Assistant
F. W. CRANDALL, B.S. _____ Assistant

Dairy

D. F. BREAZEALE, Ph.D. _____ Dairy Husbandman
ARTHUR E. DRACY, Ph.D. _____ Associate

CHASE C. WILSON, Ph.D. _____ Associate
ROSCOE J. BAKER, Ph.D. _____ Assistant
E. BARTLE, M.S. _____ Assistant

Entomology—Zoology

G. B. SPAWN, Ph.D. _____ Acting Entomologist
H. C. SEVERIN, M.A. _____ Entomologist
WM. M. ROGOFF, Ph.D. _____ Entomologist
W. L. BERNDT, B.S. _____ Assistant

Home Economics

ALICE M. ROSENBERGER, M.S. _____
Home Economist
LIDA BURRILL, Ph.D. _____ Home Economist
LILLIAN LUND, M.S. _____ Associate
E. BETH ALSUP, M.S. _____ Res. Assistant

Horticulture and Forestry

S. A. MCCRORY, M.A. _____ Horticulturist
R. L. FOSKETT, Ph.D. _____ Assistant
R. M. PETERSON, Ph.D. _____ Assistant
P. L. COLLINS, M.S. _____ Assistant

Poultry

WM. KOHLMAYER, M.S. _____ Poultry Husbandman
DEAN G. JONES, Ph.D. _____ Poultry Husbandman
C. W. CARLSON, Ph.D. _____ Associate
R. A. WILCOX, M.S. _____ Assistant

Publications

MRS. MARJORIE KING, B.S. _____ Station Editor

Rural Sociology

H. A. SAUER, M.A. _____ Acting Sociologist
W. F. KUMLIEN, Ph.D. _____ Professor Emeritus
DOUGLAS CHITTICK, M.S. _____ Associate
JOHN P. JOHANSEN, Ph.D. _____ Research Associate
R. H. DIMIT, M.S. _____ Assistant
M. P. RILEY, M.A. _____ Assistant

Station Biochemistry

O. E. OLSON, Ph.D. _____ Station Chemist
E. I. WHITEHEAD, M.S. _____ Assoc. Chemist
C. W. BONHORST, Ph.D. _____ Assoc. Biochemist
A. W. HALVERSON, Ph.D. _____ Assoc. Biochemist
GEO. GASTLER, M.S. _____ Asst. Chemist
FRANCES MOYER, M.S. _____ Asst. Chemist
L. D. KAMSTRA, M.S. _____ Asst. Chemist
CATHARINE HENDRICK, B.S. _____ Asst. Biochemist
R. M. PENGRA, B.S. _____ Research Assistant

Station Plant Pathology

C. M. NAGEL, Ph.D. _____ Plant Pathologist
GEO. SEMENTIUK, Ph.D. _____ Pathologist
ALLYN A. COOK, Ph.D. _____ Assistant
C. J. MANKIN, Ph.D. _____ Assistant

Veterinary

G. S. HARSHFIELD, D.V.M., M.S. _____ Veterinarian
T. A. DORSEY, D.V.M. _____ Associate
J. B. TAYLOR, V.M.D. _____ Associate
ELAINE J. KERNER, B.S. _____ Technician

Substations

F. W. WHETZAL, Superintendent
Range Field Station, Cottonwood
ALBERT DITTMAN, Superintendent
North Central Substation, Eureka

WADE R. PRINGLE, Superintendent
Central Substation, Highmore
HARRY E. WEAKLY, Superintendent
U. S. Newell Field Station, Newell
W. H. TREVILLYAN, Superintendent
Antelope Range Field Station, Buffalo

RESIGNATIONS

| | Date |
|---|----------------|
| Administrative | |
| Mrs. MARJORIE KING, Station Editor | May 31, 1954 |
| Agricultural Economics | |
| ERNEST FEDER, Assistant Economist | May 31, 1954 |
| Agronomy | |
| RALPH CAMPBELL, Assistant Agronomist | March 31, 1954 |
| W. C. MOLDENHAUER, Assistant Agronomist | March 26, 1954 |
| A. J. KLINGELHOETS, Associate Agronomist | June 30, 1954 |
| Animal Husbandry | |
| F. W. CRANDALL, Assistant Animal Husbandman | June 30, 1954 |
| R. M. JORDAN, Associate Animal Husbandman | June 30, 1954 |
| Entomology—Zoology | |
| W. L. BERNDT, Assistant Entomologist | May 31, 1954 |
| Poultry | |
| DEAN G. JONES, Associate Poultryman | May 31, 1954 |
| Rural Sociology | |
| J. P. JOHANSEN, Research Associate | Aug. 23, 1953 |
| Station Biochemistry | |
| ROBERT M. PENGRA, Research Assistant | Feb. 1, 1954 |
| Station Plant Pathology | |
| ALLYN A. COOK, Assistant Pathologist | March 31, 1954 |

DECEASED

Rural Sociology
W. K. KUMLIEN, Emeritus October 4, 1953

APPOINTMENTS

Agricultural Economics
R. R. NEWBERG, Assistant Economist September 1, 1953

Agronomy
D. D. HARPSTEAD, Asst. Agronomist August 1, 1953
HOWARD M. VANCE, Assistant Agronomist May 1, 1954

Rural Sociology
R. H. DIMIT, Assistant Sociologist September 1, 1953
MARVIN P. RILEY, Assistant Sociologist July 1, 1953

Financial Report—Agricultural Experiment Station—July 1, 1953 to June 30, 1954

| | FEDERAL RESEARCH FUNDS | | | | STATE RESEARCH FUNDS | | |
|---------------------------|------------------------|--------------------|--------------------|--------------------|----------------------|---------------------|-------------------------|
| | Hatch | Adams | Purnell | Backhead-Jones | Experiment | Station | Experiment & Substation |
| | | | | | | | |
| Appropriations | | | | | | | |
| Balance on Hand, 7/1/1953 | \$15,000.00 | \$15,000.00 | \$60,000.00 | \$26,510.78 | \$51,888.73 | \$335,200.00 | |
| Sale Proceeds | | | | | | | \$ 48,835.94 |
| Rentals | | | | | | | 131,772.92 |
| | | | | | | | 9,214.30 |
| Total | \$15,000.00 | \$15,000.00 | \$60,000.00 | \$26,510.78 | \$51,888.73 | \$335,200.00 | \$189,823.16 |

EXPENDITURES

| | | | | | | | |
|----------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|
| Personal Services | 8,389.86 | 12,736.18 | 47,593.74 | 19,994.05 | 39,890.64 | 248,400.00 | 27,954.59 |
| Travel | 721.58 | 27.50 | 1,255.64 | 136.03 | 437.81 | 7,176.30 | 6,372.55 |
| Transportation of Things | 1.89 | 4.51 | 188.92 | 12.04 | 15.83 | 864.25 | 223.91 |
| Communications Service | | .90 | 206.49 | | 152.25 | 1,583.86 | 599.12 |
| Rents and Utility Services | | | | | 36.00 | 2,040.78 | 905.35 |
| Printing and Binding | 3,669.87 | | 125.05 | 7.28 | 2,139.59 | 8,329.05 | 2,425.60 |
| Other Contractual Services | 237.03 | 26.26 | 505.82 | 42.68 | 189.61 | 5,612.53 | 3,580.09 |
| Supplies and Materials | 456.82 | 1,809.66 | 7,816.72 | 5,530.01 | 7,898.78 | 40,753.55 | 66,367.91 |
| Equipment | 1,522.95 | 394.99 | 2,307.62 | 788.69 | 1,128.22 | 20,429.13 | 11,702.06 |
| Land (Nonstructural Improvement) | | | | | | | |
| Total | \$15,000.00 | \$15,000.00 | \$60,000.00 | \$26,510.78 | \$51,888.73 | \$335,189.45 | \$120,131.18 |
| Unexpended balance, 6/30/1954 | | | | | | 10.55 | 69,691.98 |
| GRAND TOTAL | \$15,000.00 | \$15,000.00 | \$60,000.00 | \$26,510.78 | \$51,888.73 | \$335,200.00 | \$189,823.16 |